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The value of freshman marks as indicators of college success

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THE VALUE OF FRESHMAN MARKS
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THE VALUE OF FRESHMAN MARKS
AS
INDICATORS OF COLLEGE SUCCESS.

BY
HERBERT DANIEL LARLING

THESIS SUBMITTED FOR DEGREE OF MASTER OF SCIENCE.

MASSACHUSETTS STATE COLLEGE, AMHERST.

JUNE, 1933.

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I

INTRODUCTION

The general purpose of this investigation is to discover the actual and relative prognostic values of freshman marks as measured by the criterion college marks, and to compare these values with those of other commonly used indicators. More specifically, an attempt will be made to answer the following questions.

1. To what extent do freshman subject marks predict succeeding college marks?
2. To what extent do freshman term averages predict succeeding college marks?
3. What is the relative prognostic validity of freshman marks as compared with (a) entrance examinations, (b) intelligence tests, (c) high school marks, and (d) a combination of the latter two?
4. What is the best available method for anticipating scholastic success?

While the final answers to these questions will be definitely limited to the first term marks of three classes at the Massachusetts State College, they will, nevertheless, mark a new departure in the practice of scholastic prognostication.

Development of Scholastic Prognosis. Scholastic prognosis is largely a product of the twentieth century, but the trends which contributed to its development had their origin in preceding centuries. The three most important factors in this development have been (a) the change in the philosophy of education, (b) the realization of individual differences, and (c) the increased enrollment in colleges and universities.

1. Change in Educational Philosophy. The advent of the industrial revolution brought a change in educational philosophy.¹ (The numbers refer to the notes.) Life became an intensive competition for material possessions in an exceedingly complex civilization and since knowledge was assumed to be power, the old disciplinary education was replaced by the modern demand that education fit the individual for life by giving him definite, usable facts and techniques.² This change in educational philosophy raised the problem of how possession of facts and techniques could be measured, and brought the entire marking system under the critical gaze of educational psychologists.³ The result has been a more uniform series of standards and an increased use of objective tests.⁴ Since teacher's marks in high school work form one of the groups of data which have been used in prognosis and since "marks" in college are usually the measure of scholastic success, the increased reliability of these makes for an increased efficiency in predicting scholastic attainment.

3. Individual Differences. Darwin's doctrine of evolution posited variation in the species and led his kinsman, the English scientist, Sir Francis Galton, into the study of individual differences in man. In 1869, Galton⁵ proposed an imaginary scale for the measurement of general ability based on the principle of normal distribution, and, in 1884, he founded the Anthropometric Laboratory in London. It was

here that differential psychology and the mental test movement had their origin. Later, in 1886, he introduced the method of statistical correlation which made possible the study of certain relationships of vital data. In current practice, educational psychologists are more concerned with group testing than with individual testing, and with discovering specific abilities, aptitudes, and capacities than with "general intelligence." Numerous tests have been devised for these purposes⁶ and their widespread acceptance as measures from which future accomplishment can be predicted makes it important that they be considered, for purposes of comparison, in any study on prognosis.

3. Increased Enrollment in Colleges. One of the most notable and significant recent educational tendencies, particularly in this country, has been the marked increase in school enrollments, particularly in the colleges. At present, .0075 to 1% of the entire population is enrolled in colleges as compared with 0.25% in 1890.⁷ According to the United States Bureau of Education,⁸ forty-two landgrant colleges matriculated a total of 14,662 students in the three year period 1899 to 1902. During the period 1909-1912, forty-five landgrant colleges matriculated 26,662 students, and these same forty-five, by the period 1919-1922 had more than doubled their enrollment, having matriculated 54,921 students. This increase may be taken as indicative of what was taking place in all colleges. During the five year period 1922-1927, there was a much greater increase

than in any other period of similar length.

This flood of applications for admission placed the colleges in a new and difficult situation. More wanted to enter than could possibly be accepted and hence the colleges could select their students, attempting to choose only those who were most likely to benefit by college training. The question then was raised, "what is the best method of predicting college success?"--a problem that is still puzzling educationalists. (For the method used at M. S. C. see p.8).

Present Standing of Prognosis. In an attempt to find, or devise an efficient prognostic indicator, many educationalists turned to the secondary school mark, to the "intelligence tests," and to the entrance examinations. In general, the method has been to secure the grades made in one of the above measures and to compare these with the grades the same individuals made in college, using Karl Pearson's product-moment (or some equivalent) method of computing the coefficient of correlation. These investigations have resulted in improvements which increased the validity and reliability⁹ of the measures and raised their relational index with college work; yet considerable difference of opinion prevails at present as to the relative predictive efficiency of the three commonly used indicators, secondary school marks, entrance examinations, and aptitude tests.

1. Secondary School Marks. Odell,¹⁰ in a report of 1892 Illinois

high school students, found a correlation of .36 between their high school averages and the averages they made during their freshman year in college. He concludes that this is higher than the relationship of test scores and college marks.

Terman, tabulating the reports of twenty-five colleges, found that the coefficient of correlation between high school marks and college grades varied from .38 to .74, figures much higher than Odell's, and having the same mode as the variation .53 to .69 claimed by Roberts.¹¹ McDonnell¹² has shown that at the Massachusetts State College, High School marks correlate .47 to .63 with freshman grades.

2. Entrance Examinations. In general, entrance examinations are regarded as having a lower correlation with college marks than either test scores or high school marks, and consequently are poorer prognostic indicators. Terman and Roberts each found these examinations to correlate from .25 to .62 with college grades, but Crane¹³ reports an average correlation of nearly .40, a figure .05 higher than the correlation Odell found between high school marks and college marks, and hence, other things being equal, more efficient.

3. Aptitude Tests. The reports on aptitude tests show even greater variation in results. For example, Holway¹⁴ reports show that the Army Group Examination Alpha predicted success from .28 to .65 at Arkansas University; that it ranged from

.15 to .38 at Ohio, and that Southern Methodist University reported the highest single correlation of .52.

The most successful measure, apparently, is the Thorndike Intelligence Examination (for high school graduates). At Columbia, this test, given in 1921, was compared with the marks secured by the participants over the four year college period, and correlated as follows:

1---.56, 11---.43, 111---.36, 1V---.38

but these results have been questioned,¹⁵ as the same test at the University of Chicago gave but a .40 correlation.

The Psychological Examination has been the most widely used test and has been administered to over 750,000 college freshmen. Yet in a survey of forty-three American colleges and universities, MacPhail¹⁶ reports a correlation between the results from this test and college success of only .29, an extremely low figure. As some of the correlations reported use freshman marks as the criterion and some use the four year average, it seems probable that if the same criterion was used a smaller range of correlations would be reported.

Scott¹⁷ claims that the agreement between the scores received in mental alertness tests and the marks received during the later semesters in college is more complete than the agreement with any other procurable single factor and the general

opinion is that intelligence tests do predict work in the junior and senior years better than do high school marks, though the latter are more efficient in predicting freshman and sophomore work.¹⁸

4. Combining Results. In the face of such varied results, many colleges have attacked the problem of prognosis by analyzing college success into its elements and by testing for these elements. The resulting test scores are averaged, and the average correlated with college work. Professor Crawford¹⁹ describes such a system at Yale. Here success was analyzed into (1) the individual's inherent or potential ability, (2) his preparation for college work, and (3) the seriousness of his purpose or motivation. Scholastic aptitude tests are used to measure the first mentioned; College Entrance Board Examinations measure the preparation; and the motivation is measured by the individual's preparatory school marks, usually on a rank-in-class basis. When a composite of these three is correlated with freshman marks, it gives a coefficient of multiple correlation (R) of .66 to .73, figures which set the upper limits of the coefficients of simple correlations, but are not comparable with them because R represents the correlation between one variable and the combined effect of the other variables, while the zero order coefficients represent the relationship between but two variables. It is ^{to} be regretted that Crawford did not report the

actual simple coefficients, since these form the basis for computing the coefficient of efficiency of prediction (cf. p.20). Good,²⁰ in discussing such combinations, claims that with increased perfection of tests, a correlation of .75 to .80 with college marks should be obtained, but apparently this is far in the future.

Situation at the Massachusetts State College. The Massachusetts State College does not have a complicated system for judging applicants for admission. The only requirement is suitable proficiency in certain courses in Mathematics, English, History, and Foreign Language. These are deemed a necessary background for advanced work, and in most instances certified high school records are taken as sufficient evidence of this proficiency. Where there have been deficiencies in the high school work, knowledge of preparatory work is tested by entrance examinations. From the group of applicants who satisfy all entrance requirements (413 in the fall of 1932), the three hundred best students, as evidenced by high school records, are chosen to constitute the entering freshman class. Yet despite this careful selection, the system is not completely satisfactory. Approximately 7% of the entering class fail to do successful work and are eliminated at the end of the first term, and others leave during succeeding terms.

1. Use of Intelligence Test Scores. Although not used in considering applications for admission, intelligence scores do play

an important role at the Massachusetts State College. During the first week of college, every freshman takes a battery of three tests, and the results of these are computed and tabulated by the psychology department. These scores are then sent to the Office of the Dean, where they are used in determining the elimination from college of "border-line" cases.

2. The Assumption in Elimination. Implicit in elimination from college for failure to make passing grades in the first term work is the assumption that students who cannot do first term work will be unable to do advanced work, but, to the knowledge of the writer, no attempt has ever been made to correlate marks made in freshman work with the marks made in advanced work--with college success--to see to what extent the former predicts the latter. The only available correlations are those made at Columbia and those determined in a study made at the Massachusetts State College. Both of these studies were made with the intention of discovering the reliability of using college marks as criterion in predicting scholastic success. Wood,²¹ reporting on the conditions at Columbia, states his highest correlation of .63 as existing between the work of the freshman year and that of the sophomore year, but his results are useless for our purposes, since Columbia College uses the point-scale system and no account was taken of quality indices, all points earned with a grade of C or better being counted equally. The other study is that of Miss McDonnell²²

who found that fifty-six cases in the class of 1927 at the Massachusetts State College, there was a correlation of .77 between the first year's work and the third year's work; however, the smallness of the number of cases makes this coefficient of questionable value.

This study is made with the hope of discovering the relationship between freshman marks and advanced work, and the comparative validity of these marks and other prognostic indicators. It is also hoped that it will establish a "norm" with which succeeding research workers can compare their results. While this study is limited in scope, it is hoped that others will follow the path until there are a sufficient number of scientific facts to warrant complete generalization.

II

PROCEDURE

1. Securing the Data. The marks, averages, and other data used in this research were obtained from the records of the Registrar of the Massachusetts State College. Under the present system, which has been in use for several years, each entering student is assigned a card on which his progress through college is reported. Each subject mark and the number of credits allowed for the course is recorded, and term and yearly averages are computed, the former on a credit basis and the latter on a term average basis. The course average (four years) is also computed, on a basis of yearly averages. If the student is dropped into a lower class, his card is placed with those of that class, and in cases of elimination, the reasons are given and the card is separated from those of the rest of the class.

2. Limitations. As mentioned in the preceding chapter, the results of this investigation are necessarily subjected to definite limitations. In the first place, only three classes were considered, 1934, 1931, and 1927. Second, the study is limited to a consideration of the First Term, Freshman Year Subject Marks, although subsequent averages will be used as criteria. Third, the study is still further limited in the number of students considered. Only students who entered with and were graduated with the same class were considered. This limitation excludes all "transfers," whether from another college or from another class.

Plan of Research. In studying the relationship between freshman

averages, and succeeding averages, the data were divided by classes into three groups.

1. Class of 1934. The data of the class of 1934 were subjected to a more thorough analysis than those of the other classes. Each of the principal First Term Subject Marks, Orientation, Chemistry 4, Mathematics, English, French, and German,²³ was compared with the First Term average, the Second Term average, the Third Term average, the Freshman Year average, the Sophomore Year average, the Junior Year First Term average (the most recent data available), and with the Composite average. This Composite average was computed by adding each of the seven term averages and dividing by seven. For purposes of comparison, coefficients were also obtained of the relationship of each Freshman Term average and the Year average with succeeding averages.

In addition to the above, correlations were also made of the relationship between each First Term Subject mark used, with each Contemporary Subject mark, i.e., Orientation and English, Orientation and Mathematics, etc. To obtain more detailed facts regarding individual cases, a study was made of the marks received in other subjects by the lowest ranking members of each course. These results are discussed in section V, together with the results obtained when the succeeding averages

of these individuals were studied.

The limitation of the study to the first term freshman year subjects, is justified on the grounds that practically all the elimination from the freshman class occurs at the end of the first term, thereby making it more important to know the relation of first term marks to subsequent marks than to know the interrelations of subsequent marks. (For example, in the class of 1934, twenty-six were eliminated the first term, eleven the second, and three the third.)

2. The Class of 1931. The class of 1931 was selected for this study because, with its college entrance, in 1927, a new system of freshman grading was inaugurated. Previous to this time, all courses had been figured as contributing to the term average. Under the new system, the marks from compulsory Military and Physical Education courses (freshman and sophomore) are not considered when the grades are averaged. Since term averages are used extensively in this study, the change of averaging is of considerable importance.

With this class, only four subjects, Orientation (then known as Agriculture), Chemistry 4, Mathematics, and English were considered and these marks were compared with the First, Second, and Third Year averages and with the Course average (four years). Each Freshman Term average and the Year average was compared with the succeeding averages. French and German were not considered in

this study, because the work with the class of 1934 showed there was no relationship at all between the French marks and anything that came after, and because only a small number of students registered in German.

3. The Class of 1927. Only seven correlations were made with the data of the class of 1927, since its freshman marks were made ten years ago under vastly different conditions. With these data Orientation, Chemistry, English, and Mathematics, and each Freshman Term average was compared with the Four Year average.

4. Value Adopted in Other Prognostic Fields. The introduction discussed the variation of opinion regarding the value of other prognostic indicators. However, if the prognostic efficiency of freshman grades is to be compared with that of secondary school marks and aptitude test scores, some definite investigation must be chosen as representative of the latter two. In this research, the results found by Miss McDonnell,²⁴ in a study carried out under the direction of Professor H. N. Glick at the Massachusetts State College in 1927, will be used, for it covers, in part, the same classes. Table I summarizes her work and will be referred to when comparisons are necessary. It should be mentioned, however, that her results are high as regards correlations of the averages of the class of 1927 and the average mental test scores,²⁵ perhaps because with this class the tests were not administered until December of the freshman year and consisted only of various forms

Table 1

Comparative correlations of Mental Test scores, High School marks, and a combination of these with College averages.---Adapted from McDonnell's data (Pg. 58.)---Class 1928 equals 118 cases; class of 1927 equals 56 cases.

	Freshman Year		Sophomore Year		Junior Year	
	Class 1928	Class 1927	Class 1927	Class 1927	Class 1927	Class 1927
	r. P.T. K.e.	r. P.T. K.e.	r. P.T. K.e.	r. P.T. K.e.	r. P.T. K.e.	r. P.T. K.e.
1. Average mental test score	.361.05	.07	.511.06	.13	.581.06	.18
2. High School average	.501.05	.13	.521.05	.14	.611.05	.20
3. Combination of #1 and #2	.481.05	.12	.621.05	.21	.521.06	.14
					.371.05	.07

of the Army Alpha which is comparatively easy for college students.²⁶ With the class of 1926, this situation was changed and consequently the results of the latter correlate only .36 as compared to .51 with the class of 1927. Plantinga²⁷ also found lower coefficients (i.e., .38-.45) when she made a study here in 1930, but because she did not consider high school marks, the author deems it wiser to use McDonnell's data. No applicable norm existed between the relationship between Intelligence Test scores and the Course average, or between the former and the Composite average, so these were computed and found to be .20 \pm .07 and .29 \pm .05 respectively.

5. Nomenclature. To assure clarity in regard to terminology, a mark received in a single academic course of study is designated as a subject mark, and the general average of an individual for a completed term, a term average. Year average refers to the general average obtained from the subject marks of all courses taken during the year, this being computed at the Registrar's Office on a credit basis. Composite average, for this study, refers only to the average obtained when all the work of the class of 1934 up to and including the first term of the junior year is considered. A Course average is the average attained for the entire four years as computed by the Registrar's Office and this term will be used interchangeably with "Four Year average." Moreover, the average mark is taken as the criterion of academic

success for that term or year. In a similar fashion, a subject mark is the criterion of achievement in that particular course of study. Orientation, Chemistry, Mathematics, and English are considered the major courses of the first term and are discussed as such.

Since in this work it was necessary to group the data, a 5-point interval is adopted (i.e., 60 up to but not including 65, etc.). This term, and the terms, class and class-interval will be used synonymously in referring to this classification of data. Also in this study, the word "reliable" is frequently used. It may be defined as the degree to which succeeding comparisons with similar data will give the same results.

6. Methodology.

a. The Coefficient of Correlation. The technique in this study for determining the relationship between any two sets of variables is the product-moment method of computing the coefficient of correlation, devised by Karl Pearson,²⁶ the present director of Galton's Anthropometric Laboratory, and used by many psychologists. Table 2 illustrates the mechanics of computation. Briefly, the coefficient of correlation is the numerical index of the relationship between two sets of paired facts. It ranges from 1, a perfect positive correlation, through 0, no correlation at all to -1, a perfect negative correlation. It may be considered as measuring the degree to which a change in one set of variables tends to be accompanied by a change in the other set. Since facts obtained

in mental and educational measurements do not exhibit perfect relationship except by chance,²⁹ standards for interpreting the coefficient of correlation have been developed.

Professor Trow³⁰ advocates the following standard:

.80 to .95 very high
.60 to .80 high
.40 to .60 substantial
.20 to .40 low
.05 to .20 very low.

Another standard of interpretation is that proposed by Rugg³¹ and advocated by Jordan³² for use with educational data.

Above .60 to .70 high
.35 to .60 marked
.20 to .35 present but low
.15 to .20 negligible.

F. H. Harper³³ quotes King as suggesting these rules:

- "1. If \underline{r} is less than the probable error there is no evidence whatever of correlation.
2. If \underline{r} is more than six times the size of the probable error the existence of a correlation is practically certain.
3. When the probable error is relatively small, if \underline{r} is less than .30 the correlation cannot be considered at all marked.
4. If the probable error is relatively small, a coefficient above .50 indicates decided correlation."

In the midst of such disagreement, some standard must be assumed, and since a correlation may be low with respect to perfection, ($\underline{r} = \frac{1}{2}$), and be high with respect to existing correlations of similar attributes, this study will arbitrarily adopt

Table 2. Illustration of Pearson's Product-Moment Method of computing the coefficient of Correlation.

1934. Sophomore Year average.

1st Term
Freshman
Yr. aver.

	60-64	65-69	70-74	75-79	80-84	85-89	f	d	fd	fd ²	xy	Σxy		
85-89					3 1	18 3	4	3	12	36	21			
80-84			-6 3	8	18 9	24 6	26	2	52	104	36			
75-79			-8 8	12	9 9	4 2	31	1	31	31	5			
70-74		8	9	15	2		34	0	(495)					
65-69	3 1	16 8	9 9	5			23	-1	-23	23	28			
60-64		7	7	3			17	-2	-34	68	42			
55-59			3 1				1	-3	3	9	3			
f	1	23	37	43	21	11	(136)		(435)	(271)	(135)			
d	-3	-2	-1		1	2								
fd	-3	-46	-37	(-86)	21	22	(43)							
fd ²	9	92	37		21	44	(203)							
$\sigma_x = \frac{\Sigma fd}{N} = \frac{-43}{136} = -.316$									$\sigma_x = \sqrt{\frac{\Sigma fd^2}{N} - \sigma_x^2}$					
$\sigma_x^2 = .09985$									$= \sqrt{\frac{203}{136} - .044} = 1.178$					
$\sigma_y = \frac{35}{136} = .257$														
$\sigma_y^2 = .06604$									$\sigma_y = \sqrt{\frac{471}{136} - .066} = 1.385$					
$\sigma_{xy} = -.7081$														
							$r = \frac{\Sigma xy}{N} - \sigma_x \sigma_y$							
							$\sigma_x \sigma_y$							
							$r = \frac{135}{136} + .081$							
							$= \frac{1.0736}{1.385 \times 1.178} = .6564$							
P.E.r. = $\pm .6745$							$\frac{1 - (.656)^2}{\sqrt{136}} = \pm .0329$							

a dual standard: (a) the percent of forecasting efficiency (100% forecasting efficiency = 1.00 coefficient of correlation) as determined by Hull's coefficient of efficiency³⁴ and (b) the figure most commonly found when similar comparisons are made. The first is the standard or goal, the second is the normal or level of success thus far attained.³⁵

b. The Coefficient of Efficiency. The coefficient of efficiency represents the percent efficiency of a measure in predicting a criterion. The formula is $K.e. = 1 - \sqrt{1 - r^2}$. K.e. is thus the complement of the more widely known coefficient of alienation devised by Kelly. ($K.A. = \sqrt{1 - r^2}$). Since the coefficient of alienation measures the lack of relationship of a correlation, and consequently the inaccuracy of prognosis, its complement, the coefficient of efficiency measures the prognostic accuracy of the coefficient of correlation. Its proponent, Hull³⁶ interprets the prognostic efficiency of correlation coefficients as follows:

Below .50 practically useless
.50 - .60 possibly useful
.60 - .70 of genuine, but limited value
.70 - .80 of decided value, but rare
Above .80 not obtained by present methods.

As regards the second standard, the present level of attainment, the survey in Chapter I and McDonnell's chart (p. 15) shows that any index exceeding .50 to .60 is above average for predicting college marks.

c. The Probable Error. In the study of the relationship existing between freshman marks and future college success, we are trying

to ascertain, from a limited number of specific measures, the relationship which exists in general between these measures. For this reason, it is necessary to make due allowance for the possibility that the sample is not completely representative. Since the reliability of the coefficient of correlation depends upon two things (a) the size of the coefficient and (b) the number of cases, the probable error due to sampling may be determined by the simple formula, $P.E.r. = .6745 \left(\frac{1-r^2}{N} \right)^{.37}$ where r is the coefficient of correlation, N the number of cases, and P.E.r. is read "probable error of the coefficient of correlation." If the r is large, other things being equal, the probable error decreases; if it is small, the probable error increases; if r is 1.00, the P.E.r. is 0. If the number of cases is small, the P.E.r. is large; if the cases are few, it tends to be large. For example, in the illustration of the computation of the coefficient of correlation (Table II), we found that with 136 cases the First Term Freshman Year average correlated .656 with the Sophomore Year average. Applying these figures to the formula we find a P.E.r. of .032. This figure determines the limits within which 50% of the cases fall, i.e. that the chances are even that with another group of individuals the coefficient would fall within the range .688 to .624. The following table, compiled from data given by Munroe,³⁶ shows the number of cases included by using from 1 to 6 probable errors:

-1	P.E.	.11	P.E. contains 50.000% of cases; chances are	1.0 to 1.
-2	P.E.	.12	P.E. " 82.260% " " " "	4.5 " 1.
-3	P.E.	.13	P.E. " 95.700% " " " "	21.0 " 1.
-4	P.E.	.14	P.E. " 99.300% " " " "	142.0 " 1.
-5	P.E.	.15	P.E. " 99.924% " " " "	1,310.0 " 1.
-6	P.E.	.16	P.E. " 99.995% " " " "	19,200.0 to 1.

Statisticians differ as to the ratio which must exist between the coefficient of correlation and the probable error before the existence of a relationship can be asserted. Munroe³⁹ states: "By at least one writer the ratio is placed at six. Another writer places it as low as two or three. A conservative rule is that the coefficient must be four times its probable error before the existence of a relationship can be assumed." Jordan⁴⁰ favors "at least 3 times, better 4 times," while Otis⁴¹ says that "if important conclusions are to be based upon it, or a high degree of reliability is desired, the ratio should be increased to 3 and 4 or 5 times, respectively." To meet the most exacting standards, this study will require that the coefficient of correlation be 6 times the probable error before any relationship is considered to exist between the compared sets of variables.

III RESEARCH

1. Class of 1934. Subject marks and subsequent averages. When the marks made by 139 students in Orientation are compared with the average marks that these same students made during their entire First Year, a coefficient of correlation of $.526 \pm .041$ is obtained (Cf. Table 3). This means that the chances are even that when another group of Orientation students have their marks in that subject compared with their first year averages, under the same conditions, the coefficient of correlation will fall between .56 and .48. Since this r is 13 times the probable error, and the most exacting criterion requires but six times, this figure is reliable.

When .52 is compared with the normal, or standard attained to date in the previously employed measures (see Table 1), we find it is considerably better than the correlation ($r=.36$) between the average mental test score and the same criterion for the class of 1928, and slightly better than that of the class of 1927 ($r=.51$). It is also better than the High School index for each class, though the difference is very slight here ($r=.50+.52$). Since the correlations found by Terman to exist between entrance examinations and college work have a mode of but .43, Orientation is higher than this also. This means that Orientation marks predict the average which will be obtained for the first year work better than do any of the other commonly used indicators, though the difference here is so slight that more studies will have to be made before a suitable generalization can be made.

Table 3

Coefficients obtained when Subject marks and Term averages are correlated with the Freshman and Sophomore averages. Class of 1934.

	Freshman Year average				Sophomore Year average			
	R.	P.E.	Cases	K.E.	R.	P.E.	Cases	K.E.
Freshman Year								
1st term	.866±	.014	143	.49	.656±	.032	136	.24
2nd term	.900±	.010	143	.56	.750±	.025	138	.34
3rd term	.869±	.013	143	.49	.889±	.012	137	.52
Freshman Year average					.789±	.021	136	.37
Orientation 1	.526±	.041	139	.14	.470±	.044	139	.11
Chemistry 4	.670±	.036	106	.26	.547±	.045	110	.15
English 1	.525±	.041	142	.14	.420±	.046	143	.09
Mathematics 1	.705±	.029	135	.29	.459±	.046	134	.10
French 4	.453±	.078	47	.10	.275±	.097	41	.14
German 1	.766±	.036	59	.35	.520±	.063	60	.14

Table 4

Coefficients obtained when Subject merits and Term averages are correlated with the Junior and Composite average. Class 1934.

	Junior Yr.	1st Term	Cases	K.e.	Comp. aver.	K.e.	Cases
	<u>R.</u>	<u>P.E.</u>			<u>I.</u> <u>P.M.</u>		
Freshman Yr. 1st term	.424	.048	130	.09	.644 .03	.22	130
" " 2nd "	.5564	.040	130	.16	.734 .02	.33	130
" " 3rd "	.6384	.035	130	.22	.7984 .02	.38	129
" " average	.5761	.039	129	.17	.684 .03	.23	129
Orientation 1	13794	.050	132	.07	.4584 .046	.10	132
Chemistry 4	.504	.050	132	.13	.574 .039	.17	100
English	.3364	.051	135	.06	.424 .04	.09	135
Mathematics	.3294	.053	128	.05	.4974 .05	.13	128
French	.1194	.106	39	.05	.284 .09	.04	39
German	.6454	.053	55	.23	.624 .05	.22	55

When $r=.52$ is compared with perfection, the results are much less significant. Applying the r to Hull's formula gives a coefficient of efficiency (K.e.) of but 14%, which may be interpreted as meaning that there is approximately one chance in seven that an individual will make a year average in the same class as his term mark in Orientation. While this is low, it will be found that it compares very favorably with many of the other marks, and exceeds every other indicator with the single exception of high school averages and the class of 1927, First Year average, which it equals. The general conclusion to be drawn is that Orientation is as good as any indicator and better than most in predicting the First Year average, but that it is still far from perfection.

The relationship existing between Orientation and the Sophomore average is somewhat lower than the relationship with the First Year average. Since the r is .47 and the P.E. only .04, however, this figure is reliable, and the chances are even that in repeating the correlation the new coefficient will fall between .43 and .51. When compared with McDonnell's results, .47 is found to be a low coefficient. Both mental test scores and high school averages have greater relationships with Sophomore work, the former giving an r of .58 and the latter an r of .61. It is, however, higher than the .43 r which Terman found with entrance examinations.

A correlation coefficient of .47 is also found to be unsatisfactory when compared with perfection, for it has a K.e. of but 11%, which means that there is approximately one chance in nine that an individual will make an average in his sophomore year in the same class as he did in his first term Orientation course. Hence we can conclude that there is a definite relationship between these two variables, but that it is lower than the other commonly used indicators, and is of less value for prognostic purposes.

The coefficient of correlation between Orientation and the First Term Junior Year average is very low: $.37 \pm .05$, 10 points lower than the relationship with the First Term. Consequently, while reliable (six times its P.E.), it has a predictive efficiency of but 7% and is of little practical use. When compared with the degree to which mental tests predict this term's work, however, Orientation is found to be somewhat better. Table I shows that McDonnell obtained an r of only .31, and as this gives a K.e. of 5% (one chance in twenty) and as Orientation predicts with 7% accuracy, the latter is the better measure. High school averages, with an r of .47, are much better, however, than either mental tests or Orientation.

A correlation of $.46 \pm .04$ is obtained between Orientation and the Composite average, a reliable figure that is higher by 8 points than the relationship with the Junior First Term marks. As

regards to normal, this r is found to be almost twice as large as that of .29 obtained when Intelligence Test scores were compared with the Composite average. This r gives a $K.e.$ of .10, and means that the mark received in Orientation is 10% efficient in predicting the average grade the student shall have received at the end of the First Term of his Junior Year in college, *i.e.*, a student making a grade of 40% in his Orientation course will have one chance in ten of making a Composite average in the same interval. While succeeding comparisons will show that this figure is relatively low, it is evidence of a genuine relationship.

Chemistry and Succeeding Averages. With 106 cases, Chemistry correlated .67±.03 with the average made during the First Year. This coefficient is more than six times its $P.E.$ and is reliable. It is larger by 15 points than the r of the relationship of Orientation and the same criterion, and from 15 to 17 points higher than the r 's found when Mental Test scores and High School marks are used as indicators. Consequently it is, to date, the best prognostic indicator we have of First Year averages.

When compared with perfect prognostic efficiency, however, the figure is low, since it gives a $K.e.$ of but .26, which gives an individual but one chance in four of duplicating for the First Year the interval in which his Chemistry mark fell.

Although it is larger than the coefficient found between any other First Term subject and the Second Year work, the r of Chemistry and the Second Year average is 13 points lower than that found to exist between the same subject and the First Year averages. The coefficient is $.47 \pm .04$ and is reliable, since it is more than eleven times its own $P.E.$ It is, however, lower than the relationship between both Mental Test scores ($r = .58$) and the same criterion and High School averages and Sophomore Year averages ($r = .61$) and consequently is low (although less so than other subjects) as regards the normal standard.

The relationship between Chemistry and Second Year averages is decidedly low when compared with perfection, as its r gives a $K.e.$ of but $.15$. Consequently, an individual has but three chances in twenty of repeating, for the Sophomore year, the class in which he places his Chemistry mark.

A coefficient of correlation of $.50 \pm .05$ is obtained when the Chemistry marks are compared with the average the same students made in the First Term of their Junior Year. This figure, being ten times its $P.E.$, is reliable. It is 4 points lower than the relationship between the same subject and the work of the Sophomore Year, and 17 points lower than the same marks when compared with the Freshman Year averages. Consequently, there is a diminishing relationship between Freshman Chemistry marks and the averages of succeeding years. Despite the fact that it is lower than the r 's of Chemistry and the

averages of the First and Second Years, .50 is considerably higher than the $r = .31$ found to exist between Mental Test scores and the Junior Year First Term average. It is also 3 points higher than the relationship between High School averages and Junior work. Consequently, it is high as regards the Normal Standard.

When compared with perfection, however, Chemistry is found to be only 13% efficient in predicting the average which will be made in the First Term of the Junior Year. This gives but two chances in fifteen of placing in the same interval in both Chemistry and Junior work.

Chemistry has the second highest relationship of all the subjects (See German, $r = .62$, p.39) with the criterion Composite average. Here an r of $.57 \pm .03$ is obtained, a reliable figure that is higher than the r obtained when the same marks are compared with the Sophomore and Junior averages, but is lower, by 10 points, than the r of Chemistry and First Year averages. Since it is also higher (by 37 points) than the coefficient existing between the Cross Intelligence Test scores and the same criterion, the figure may be considered high as regards normal.

The relationship is not as satisfying, however, when compared with the goal, perfection. Applied to Hull's formula, $r = .57$ gives a $k.e.$ of .17. This $k.e.$ allows approximately one chance in six of repeating in the Composite average, the same class as one made with the Chemistry mark in the First Term.

This study has shown that Chemistry is consistently the second best subject indicator of subsequent college success, for though its efficiency decreases somewhat with each succeeding year, it rises when the Composite average is considered. Chemistry is also superior to high school marks and mental test scores as prognostic indicators excepting with Sophomore averages.

English Marks and Subsequent Averages. The marks made in First Term English are poorer indicators of succeeding college averages than are the marks made in Orientation or in Chemistry. When compared with Freshman Year averages, an r of $.52 \pm .04$ is obtained, and this figure is reliable, as it is more than ten times its P.E. Hence the same comparison made with other data would have an equal chance of having an r within the range, .48 to .56. As .52 is also the r found for Orientation and First Year averages, the two subjects are of equal efficiency in predicting success.

English, however, has a 15 point lower correlation with Freshman Year averages than has Chemistry, and consequently is much less efficient, for prognostic purposes. When compared with the relationship found between Mental Test scores, High School averages and Freshman averages, English is found to be approximately their equal. The r which McLonell found between these variables was .51 for Mental Tests, and .52 for High School marks, and as English correlates, .52, the three are of approximately the same value.

The K.e. of the English r is but .14, and this is low as regarding perfection, since an individual has but one

chance in seven of making an average for the Freshman Year that will fall in the same class as the mark he made in English.

The inefficiency of English marks as indicators is better shown by comparing these marks with the Sophomore Year average. Here an r of $.42 \pm .04$ is obtained. This figure is reliable, but is .05 lower than the coefficient between Orientation and the same criterion and is 12 points lower than the Chemistry correlation with the same year's work. This comparison shows that while Orientation and English are of equal value in predicting First Year work, Orientation is better for predicting Second Year work. Chemistry is better than either of them in predicting the work of both the Freshman and the Sophomore Year.

English was found to be equal in value with high school marks and mental test scores in predicting first year work, but both of these indicators are higher than English in the prediction of second year work, Mental Test scores correlating .58, and High School averages correlating .61.

Since the k.e. of English in predicting Second Year work is but .09, it is much below perfection.

The tendency for English marks to have a lower correlation with advance marks, noted above, is continued into the junior year. When compared with the average attained during the First Term of this year, English shows an r of but $.33 \pm .05$,

a figure barely reliable (six times its P.E.) and one lower than those of Orientation, Chemistry, and High School averages when they are compared with Junior Year work. It is, however, higher than the figure obtained by McInnell when she correlated Mental Test scores and the Junior work, for she obtained an r of but .31. English is but 6% perfect in predicting Junior Year First Term work, and this figure shows how much improvement is needed before English marks should be used for predictive purposes (according to this criterion).

Like each of the preceding correlations we have studied, English has a higher correlation with the Composite average than with the Junior Term work. The r is .42±.04 and is reliable and equal to that of English and the Second Year work, though lower than the First Year work. Comparatively, English is low in predicting Composite averages, since both Chemistry and Orientation have higher r's, the former being .58 and the latter .45. It is, however, 13 points higher than the r of Intelligence Test scores and the same criterion.

When compared with perfection, r = .42 is found to be 9% efficient. Consequently, the chances are one in eleven that the individual will repeat his class-interval.

From this study, we may conclude that English is a poor prognostic indicator of college success. It is consistently lower than Chemistry, and while equal to the relationship

Orientation, mental test scores, and high school averages with the first year's work, it is lower than these in all succeeding comparisons, with but one exception, that of mental test scores and junior work. At its best, with the freshman year marks, English is but 14% perfect in prediction.

Mathematics and Subsequent Average. There is an even greater decline in the amount of relationship between Mathematics marks and the work of succeeding years than was found with English marks. With the First Year's work, an r of .70±.02 is obtained, the highest correlation studied to date. This figure is 35 times its $P.E.$, and is therefore very reliable. It is from 3 to 19 points higher than Orientation, Chemistry, English, mental test scores, and high school averages, when these are compared with the same criterion; Chemistry, with an r of .67, is its nearest rival. Hence the figure is high in regard to normal, and it places in the group of correlations which Hull (p. 20) calls "good but rare" for predictive purposes.

When compared to the standard of perfection, Mathematics is found to be relatively high since it has a $k.e.$ of 29%, which means that an individual has slightly more than one chance in four of having his marks for the First Year's average in the same interval as his Mathematics marks.

Mathematics loses its significance as a prognostic indicator when the marks are compared with the Sophomore work,

for it is over 60% less efficient. An r of $.45 \pm .04$ is obtained, which, while reliable, has a $K.e.$ of but 10, as compared with the $K.e.$ of .29 obtained above. Mathematics also loses its significance when compared with the normal standard, for it drops from first place as a predictor of First Year work to fifth place in predicting Second Year work. Only English is inferior to Mathematics in predicting this year's work, and that is but 3 points lower.

The decrease in prognostic efficiency continues into the Third Year, where a coefficient of $.32 \pm .05$ is obtained, a figure barely reliable according to the adopted criterion, six times the $P.E.$ This coefficient places Mathematics fifth of the six indicators studied so far in predicting Junior Year First Term work, for while it is lower than the English r , which it surpasses in the study immediately preceding, it is 1 point higher than the Mental Test scores. This $r = .32$ represents a drop of 38 points from the r obtained when Mathematics marks were compared with the First Year averages, and has a $K.e.$ of but 5%, which makes it of no value in predicting Junior work, since an individual has but one chance in twenty of placing his mark in the same class.

When compared with the Composite average, Mathematics again assumes a comparatively high standing, for an r of $.49 \pm .05$ is obtained, which places the subject second only to Chemistry which has an r of .57, 6 points higher. Moreover, the coefficient obtained from this comparison is higher than any other

Mathematics r with the exception of the First Year, for it has a K.e. of 13%, which gives the individual slightly more than one chance in seven of repeating his class.

A summary of the above data shows that Mathematics is the best indicator of work in the Freshman Year that we have studied, being superior to Orientation, Chemistry, English, Mental Test scores, and High School averages, but it is a comparatively poor indicator of the Second Year's work and of the First Term Junior Year work. It stands second among the indicators of Composite averages, however, predicting these better than any other marks excepting the First Year's work.

French and Succeeding Averages. French is the poorest prognostic indicator of all the First Term Freshman marks. When compared with the Freshman Year average, a coefficient of .45±.07 is obtained. This figure is barely reliable, since it is six times its P.E. The P.E. is large because only forty-seven cases are considered and because .45 is a relatively low coefficient. This coefficient is 7 points lower than that of English when compared with the same criterion and is 31 points lower than German and First Year averages, the most efficient prognostic indicator of all Freshman First Term marks. It is also from 6 to 7 points lower than the correlations obtained when Mental Test scores and High School marks are correlated with Freshman Year averages. Consequently, it is of no pre-

dictive value when compared with the normal level of attainment, and since its K.e. is but .10, it predicts only one case in ten where an individual will make a First Year average in the same class as his First Term mark in French.

When compared with the Sophomore Year average, French is found to be 18 points lower than the correlation with the First Year average. Here an r of .27±.09 is obtained, a figure not reliable, since it is but three times its probable error. This figure is 15 points lower than the worst of the other subject marks and is from 31 to 44 points lower than the best correlations obtained by McDonell. Even if the probable error were small and the coefficient reliable, it would have little predictive efficiency, since its K.e. is but 4%.

A coefficient of .11±.10 is obtained when the first term French marks are compared with the averages made in the First Term of the Junior year. This figure is absurdly low, being barely larger than its probable error and having a coefficient of efficiency of but .005 which means that an individual has but one chance in two hundred of placing his mark in the same interval in the Junior Year.

Although still unreliable, the correlation obtained when French marks are compared with the Composite average is somewhat better than the two preceding coefficients. An r of .28±.09 is obtained here, a figure but three times its probable error.

The study of the relationships existing between French marks and succeeding college averages indicates little or no relationship. Only the coefficient obtained when these marks are compared with the First Year average is reliable and this is so low in comparison with the relationships of other contemporary marks and the same criterion that it should not be considered for predictive purposes.

German Marks and Succeeding Averages. While but fifty-two to fifty-five cases are considered in the comparison of German marks and succeeding averages, higher coefficients are obtained than with any of the other First Term Subject marks. When compared with the First Year average, German marks give a correlation of $.76 \pm .03$, a figure that is thoroughly reliable. This index is 6 points higher than that obtained between the Mathematics marks (which is the second best indicator) and the First Year average, and is 24 points higher than the r obtained by McDonell with either Mental Test scores or High School marks. When compared with perfection, German also stands high, having a K.e. of $.35$ and consequently predicting First Year averages with 35% efficiency. It must be remembered, however, that but fifty-five cases are considered and this number is far too small to allow for generalization.

When compared with the Sophomore Year average, the marks made in German are found to correlate $.52 \pm .06$, a reliable figure that places German second only to Chemistry in the correlation

of subject marks and Sophomore Year averages, although it is lower than both the coefficient obtained between Mental Test scores and the Sophomore Year and High School averages and the Sophomore Year (Table 1). This figure has a K.e. of .14 which means that an individual has one chance in seven of placing his Sophomore Year average in the same class as his German marks.

German predicts the average obtained in the First Term Junior Year better than any other subject and better than Mental Test scores and High School averages. A correlation of $.64 \pm .05$ is obtained between these two variants, a figure that is 14 points higher than the r obtained between the same subjects and the Sophomore Year work. Consequently, it has a predictive efficiency of 23% and gives an individual approximately one chance in four of repeating his interval.

German retains its relatively high predictive efficiency when compared with the Composite average. Here the coefficient is $.62 \pm .05$, a figure that is thoroughly reliable and is .05 higher than that of Chemistry and the Composite average, the second best subject for indicating Composite averages. This figure is superior to that obtained between German and Sophomore Year averages and is only .02 lower than that of German and the Junior Year First Term averages. It is 33 points higher than the relation which exists between Intelligence Test scores and the same criterion. Since it predicts the Composite average with 22% efficiency, it is better than all other sub-

jects examined in this respect, Chemistry being second best with a K.e. of 17%.

While the coefficients, obtained when the First Term marks in German are compared with subsequent averages, are in every case but one higher than those obtained from other indicators, it is important to remember that approximately only one-third of the entire class studied this subject. Consequently, while relatively high in predictive efficiency, German marks are applicable only to a limited number of cases. A peculiarity to be observed is that German is the only subject which predicts Junior First Term work better than it predicts the Sophomore Year work; all others give evidence of decreasing predictive efficiency when compared with Freshman, Sophomore, and Junior First Term averages.

Freshman Year Term Averages and Succeeding Averages. In every case but one (exception will be discussed later), Freshman Term averages have a closer relationship with succeeding averages than have any other indicators.⁴² (cf. Table 4).

First Term Freshman Year averages correlate $.86\pm.01$ with the Freshman Year average, a correlation that is in the "not obtained by present methods" classification of Hull. This figure is more than eighty times its probable error and the most exacting standards require but six times for reliability. The r is 10 points higher than the highest subject mark correlation with the same criterion (German, .76) and is

approximately 35 points higher than the relationship existing between Mental Test scores and First Year averages and between High School averages and First Year averages. It has a predictive efficiency of 49%, which means that there is almost an even chance that an individual will make a Freshman Year average that falls in the same interval as the average he makes with his First Term's work. It should be noted, however, that in comparing First Term work with the Freshman Year average, a part is correlated with a whole, since the First Term average is approximately one-third of the data from which the Year average is computed. This factor is undoubtedly partly responsible for the high coefficient obtained.

The factor of common elements does not, however, enter into the correlation of Freshman First Term averages and the Sophomore Year average, yet here an r of $.65 \pm .03$ is obtained. This figure is reliable and is higher than that obtained by any other indicator when compared with the same criterion. It is, however, not as satisfactory for prognostic purposes when compared with the standard of perfection, since it has a prognostic efficiency of but 24%.

The First Term average does not predict the First Term Junior Year work as well as it does the work preceding this term. A coefficient of but $.42 \pm .04$ is obtained and this figure, while reliable, is lower than the relationship existing between High School marks, English, German, and the same criterion.

This is the exception noted at the beginning of this section and represents the only instance where other indicators have a closer relationship with a criterion than has a term average. When applied to Hull's formula, $r = .42$, gives a k.o. of but 9%, a figure 50% lower than the coefficient of efficiency obtained when any other Freshman Term average is compared with succeeding averages.

A much more significant coefficient is obtained when the averages made in the First Term are compared with the Composite averages. The r obtained is $.64\pm .03$, a figure 22 points higher than that obtained when the same indicator is compared with the Junior Year Third Term average. This figure is thoroughly reliable is better than the coefficient obtained when individual subjects are compared with the Composite average. It is 22% efficient and is consequently relatively high although far from perfection.

This section of the study may be briefly summarized by saying that the averages made in the First Term of the Freshman Year predict the average of the Freshman Year better than they do the averages of succeeding years and they have the lowest relationships with the averages of the Junior Year, First Term. In every case, with the single exception of the correlation obtained with the Junior Year, the First Term average is more efficient as a prognostic indicator than any other indicator thus far studied.

Second Term Averages and Succeeding Averages. The coefficient obtained when the Second Term averages are compared with the First Year averages is the highest obtained between any two variables studied. Here a coefficient of $.90 \pm .01$ is obtained, an r which almost approaches perfect positive correlation ($+1.00$). This figure is 4 points higher than the coefficients obtained when the averages of the other two Freshman Terms are compared with the Freshman Year work and is from 14 to 38 points higher in the correlation of the marks made in First Term subjects and the same criterion. It is also approximately 40 points higher than the correlation found by McLonell to exist between Mental Test scores, High School averages, and First Year work, and consequently is exceedingly high when compared with the normal standard. Since an r of $.90$ has a k.e. of $.56$, it is also an efficient indicator of succeeding work when compared to the standard of perfection. This index indicates that an individual making a Second Term average of 80% (for example) would have 14 chances out of 25 of making a Freshman Year average which would place in the same class ($80\%-84\%$).

As a caution against placing too much emphasis upon the highness of this coefficient, it should be noted that only 143 cases were considered and that it represents the correlation existing between a part and a whole and is therefore probably higher than that which would exist when an indicator with no common elements is compared with the same criterion.

When compared with the Sophomore Year average, the

Second Term Freshman Year marks give an r of $.75 \pm .02$. This figure is reliable and is 10 points higher than the r obtained when the First Term marks are compared with the Sophomore Year average. This figure is also higher than any other coefficient obtained in the comparison of other indicators and Sophomore work. It has a $K.e.$ of $.14$, which means that an individual has slightly better than one chance in three of making a Sophomore Year average which will fall in the same class as did his Second Term Freshman Year average.

The relationship between the Second Term Freshman Year average and the Junior Year First Term average is shown by the index $.55 \pm .04$, a figure 20 points lower than the coefficient obtained when the same indicator is compared with the Sophomore Year work. This r is higher than that found when individual subjects are compared with Junior Year work and it is also larger by from 8 to 24 points than the r 's obtained by McDonell. When compared with perfection, however, it is found to be rather unsatisfactory, since it has a coefficient of efficiency of but $.16$.

A closer relationship exists between the averages of the Second Term Freshman Year and the Composite average than exists between the same indicator and the Junior Year work. This correlation gives a coefficient of $.73 \pm .02$ which is 11 points higher than the correlation of German (the best subject mark relationship) and the same criterion. It is also almost

two and one half times the r of Intelligence Test scores and the Composite average. Consequently, it is high as regards the normal standard. When compared with the standard of perfection, the coefficient of correlation, .73, is found to be 33% efficient, and is hence relatively high.

From this study of the Second Term averages and their relationship to subsequent averages, it will be noted that they are consistently better indicators than are First Term averages or the subject marks.

Third Term Averages and Subsequent Averages. The Third Term averages and the Freshman Year averages correlate $.86 \pm .01$, a figure equal to that of the First Term and the same criterion but .04 lower than the r of the Second Term average. This coefficient is reliable and when compared with the level of attainment to date is significant, being at least 10 points higher than the coefficient obtained when any other indicator (excepting Term averages) is compared with the same criterion. Like the First Term average, it has a $K.e.$ of .49, and shows that there is almost an even chance that an individual will duplicate the class in which his averages fall.

The Third Term average is the best indicator of the Sophomore Year work investigated. When these two variables are correlated, a coefficient of $.88 \pm .01$ is obtained and this figure is 13 points higher than the second best indicator, Second Term work. Further, it is 27 points higher than the relationship found by McDonnell to exist between High School averages and the

Sophomore work and is 34 points higher than the relationship between Chemistry, the best indicator of the subjects, and the same criterion. When compared with perfection, this coefficient is found to be 52% effective in predicting Sophomore Year work, which means that the individual has one chance in two of placing his Sophomore Year average in the same interval as that of his Freshman Year Third Term average.

Third Term work is also more closely related with Junior Year First Term work than is any other Term average. Its coefficient is $.63\pm.03$ and this is 8 points higher than the Second Term relationship. This figure is also higher than the r 's obtained when Mental Test scores and High School averages are used as indicators and when subjects, with the exception of German, are correlated with the same criterion. German, however, considers but fifty-five cases as compared with 129 in the Third Term work and consequently (since its r is but 1 point higher than the Third Term work) it is not as useful for practical purposes.

As in every case considered, the relationship existing between the Third Term average and the Composite average is higher than that of the same subject as compared with the Junior Year, the difference in this case being 16 points. The coefficient $.79\pm.02$ is reliable and is the highest index obtained when various indicators have been compared with the Composite averages. Consequently, the Third Term average prognostic indicator of Composite averages that has been at-

tained to date although it is but 38% perfect.

We may summarize this section of our study by saying that in general the average made in the Third Term of the Freshman Year is the best available indicator of subsequent college success. Although the relationship between the Third Term average and the Freshman Year average is 4 points lower than that between the Second Term average and the same criterion, the former indicator is considerably better in predicting Sophomore, Junior and Composite work and is the only indicator studied which is more efficient in predicting Sophomore Year work than Freshman Year work.

Since most of the need for an indicator of future college success comes before the beginning of the Sophomore Year, the relationship of the Freshman Year average and subsequent success is of little practical use. For purposes of comparison, however, this average has been compared with that made in the Sophomore Year, Junior Year, and Composite average. In each case, the r is higher than that obtained when the First Term average is compared with the same criterion, but is lower than the relationships between the Second Term and Third Term and the same variable. The figures are all reliable being .78±.02; .57±.03; and .68±.03 and are higher than the relationships between individual subjects and subsequent averages.

Summary of 1934 Comparisons. This study has shown several definite tendencies. The most noticeable of these is that, taken as a whole, the marks and averages made during the Freshman Terms correlate higher with the average made the Second Year, and more highly with the Second Year than with the First Term of the Junior Year, and that they tend to have a coefficient of correlation with the Composite average which is approximately equal to that of the Second Year.

Term averages were found to be considerably better than the marks of individual subjects in predicting the averages of succeeding years and were about equal to each other in this respect.

Subject marks were found to vary considerably in the closeness of their relationship with succeeding averages, and, in general, German (r = range, .52-.76) was found to correlate the highest, though it had the fewest number of cases. Of those subjects having approximately the same number of cases, Chemistry was found to be the best in predicting the college success of the class of 1934, while Mathematics and Orientation were equal to each other and ranked second. English had the lowest predictive value of any subject in this group. French, with but a few cases, was found to be extremely low, and to have only one coefficient that was reliable.

2. Class of 1931. Table 5 shows the coefficients obtained when the subject marks and year averages of the class of 1931 were subjected to an analysis similar to that given to the class of 1934. In general, the results are similar, but lower than the indices obtained in the preceding studies.

Orientation Comparisons. The coefficients found when the Orientation marks are compared with the succeeding year averages are higher than those found in similar comparisons with the data of the class of 1934, but the difference is slight. When compared with the First Year average, Orientation marks give a coefficient of $.76 \pm .03$, a figure that is reliable and is higher than the r 's obtained when the same subject marks are compared with the averages of the Second and of the Third Year. This index is 24 points higher than the one obtained for the same comparison with the 1934 data, and it is 25 points higher than the r of Mental Test scores and the same criterion. It is also higher than the r of High School marks when they are compared with the First Term average.

When compared with the standard of perfection, orientation is found to be 35% efficient. Consequently it gives an individual approximately one chance in seven of placing his term average in the same interval as that in which he places his Orientation mark.

When the marks made in Orientation are correlated

Table 5

Relationship existing between the merits and averages of the Class of 1931

Subject	Freshman Year average			Sophomore Year average		
	r.	P.E.	Cases	r.	P.E.	Cases
Orientation	.7604	.030	87	.5674	.050	82
Chemistry	.6084	.053	62	.3364	.077	59
Mathematics	.6334	.043	87	.2704	.069	81
English	.5194	.052	87	.3414	.065	82
Subject	Junior Year average			Four Year average		
	r.	P.E.	Cases	r.	P.E.	Cases
Orientation	.3274	.064	88	.5204	.051	89
Chemistry	.3644	.074	62	.4554	.056	87
Mathematics	.1254	.071	87	.4704	.055	88
English	.1624	.070	88	.3414	.063	89

with the average of the Second Year, an index of .564.05 is obtained. This figure is reliable, for it is over six times its P.E. The chances are even that the true coefficient lies between .51 and .61 and they are twenty-one to one that it lies between .46 and .66.

This coefficient is lower than that obtained when Orientation was compared with the First Year average, but it is higher than the r of the same comparison when made with the data of the class of 1934. The difference between the r's of the two sets of data is much less in this comparison, however, than in the preceding one. Here they differ by but 9 points.

Orientation has a higher relationship with the averages of this year than have any of the other subjects considered (Orientation, Chemistry, Mathematics, and English) and consequently is a better prognostic indicator of the averages which will be made in the Second Year. It is lower, however, than r's of both Mental Test score and High School averages when they are compared with the same criterion. Consequently we may summarize by saying that with the class of 1931 the Orientation marks were better prognostic indicators of the Sophomore Year averages than were the same marks in the class of 1934, and that they predicted better than any other First Term subject, but poorer than did the High School marks and the Mental Test scores.

When compared with the average of the Junior Year,

Orientation is found to be a poorer indicator. This comparison gives an r of $.32 \pm .06$. This figure is not reliable according to the standards adopted for this study, and it is the only Orientation comparison of those made with the data of the classes of 1931 and 1934 which does not give a reliable coefficient.

This coefficient, even if it were reliable, would be relatively low, since it is .05 less than the r obtained in the same comparison with the 1934 data; is .15 lower than the relationship index obtained for High School averages and the same criterion, and is .02 lower than the r of the 1931 Chemistry marks and the Junior Year average. It is, however, higher by 1 point than the r of the Mental Test scores. Orientation regains its rank as the best subject indicator of future success when the marks made in this subject are compared with the average made for the entire Four Years. This coefficient is $.52 \pm .05$, a figure well over the required six times its $P.E.$, and is consequently a reliable index. This is 5 points higher than the r of any other subject mark and the same criterion and is over 30 points higher than the relationship found to exist between Intelligence Test scores and the course average.

When compared with perfection, it is found that Hull's formula gives a $k.e.$ of .14, which indicates that an individual has almost one chance in seven of repeating his class-interval.

The study of the Orientation marks of the class of 1931 and their relationship with subsequent averages can be summarized by saying that Orientation predicted the averages of each year but the third better than did any other subject, and better than did the same course in the 1934 data. It was a poorer indicator than the High School averages and the Mental Tests for the Sophomore Year averages, and was poorer than former in the Junior Year comparison. It should be noted that this study gave a fine example of the decreasing relationship between a subject mark and subsequent averages, since there was a drop of approximately 20 points in each succeeding r and a rise to about the Sophomore level in the r of the entire course. The r of Orientation and the First Year average was .76; the r of the Second Year was .56, and the r of the Third Year was .38, while the Four Year average gave an r of .52. This is a tendency which has been noted before and which persists throughout the entire study.

Chemistry Comparisons. Unlike Orientation, Chemistry marks in the 1931 data consistently gave lower r 's than did the same subject in the 1934 data. When compared with the First Year average, Chemistry gave an r of .60±.05. This is reliable but is relatively low when compared with the r 's obtained when other First Term subjects are correlated with the same criterion; Orientation and Mathematics both surpassed it. This figure is also low when compared with the r of the similar comparison made

with the 1934 data, as this gives .67, 7 points higher. Chemistry does predict the average which will be made in the First Year better than Mental Test scores or High School averages, however, and consequently is more efficient than they are.

When compared with the Sophomore Year average and with the Junior Year average, Chemistry marks do not give reliable coefficients. The r for the former comparison is .33 $\frac{1}{2}$.07 and for the latter is .36 $\frac{1}{2}$.07. Both figures are lower than those obtained with the 1934 data, and since they are not reliable are useless for prognostic purposes.

A reliable figure is obtained when the Chemistry marks are correlated with the Four Year average, as an r of .45 $\frac{1}{2}$.05 is obtained, but this figure is lower than the r of Orientation and Mathematics when these subjects are compared with the same criterion. It is, however, superior to the r 's of both English and the Intelligence Test scores.

Chemistry is shown in this study to be of little value in predicting subsequent college success. It has a reliable relationship with only two criteria, First Year averages, and Course averages, and is third among the four subjects compared with these averages.

Mathematics Comparisons. Mathematics is only slightly better than Chemistry as a prognostic indicator of succeeding college success. Like Chemistry, it gives only two reliable coefficients,

those of the First Year average and of the Four Year average and like Chemistry also it gives lower r 's than were obtained when the same comparisons were made with the data of the class of 1934. The only way in which it is superior to Chemistry is in the slightly higher r 's obtained when it is compared with the First Year average and with the Four Year average. In the former case, an r of .63±.04 is obtained, and in the latter, an r of .47±.05. Both of these r 's are sufficiently high to place Mathematics second among the subjects in predicting these averages, but both are low as regards perfection, having $k.g.$'s of but .20 and .11 respectively.

English Comparisons. English is by far the poorest of all the subjects considered as prognostic indicators. When compared with the average made in the First Year, it gives the lowest coefficient of all the subjects, only .51±.05, and this is the only reliable index it does give. This r is 9 points lower than the r of Chemistry, the second poorest indicator, and slightly lower than the r 's of the Mental Test scores and the High School averages when these are compared with the same criterion. It is 19 points lower than the r of the same comparison made with the 1934 data.

None of the r 's obtained when English marks are compared with the averages of succeeding years and with the Four Year average are reliable, and consequently they cannot be considered in a search for prognostic indicators. English gives

an r of $.34 \pm .06$ with the Second Year averages, of $.16 \pm .07$ with the Junior Year, and of $.34 \pm .06$ with the Course average.

Summary. When the relationship between the courses of the First Term, and the averages of the succeeding years and of the Four Years were computed, it was found that they followed the general tendency to have a lower coefficient with advanced years, and to have a coefficient with the Course average that was approximately equal to that of the Sophomore Year. It was also found that with the exception of Orientation, each subject had lower r 's than were obtained when the same comparisons were made with the data of the class of 1934. Another point that should be noted is that none of the courses gave a reliable r when compared with the average of the Junior Year, and that there were, in general, considerably more unreliable coefficients than there were in the class of 1934. Part of this may be due to the fact that there were fewer cases considered.

Relationships of Term Averages and the Course Average. For purposes of comparison, the coefficients of the relationship of each Freshman Term average with the Course average were computed. These are given in Table 6 below, and show that in every case the r is reliable and that it is larger than the highest r obtained from a comparison of the Subject marks with the Four Year average. Since the nearest r to these is that of Orientation and the same criterion, and that is only .52, 14 points lower than the lowest index of Term averages relationships, the lat-

ter are much superior as prognostic indicators. When compared with perfection, they are poorer however, as their k.e.'s range from only .25 to .53.

Table 6
Relationship Between Term Averages
and the Four Year Average, Class 1931

	Four Year Average			Cases
	<u>r</u>	<u>P.E.</u>	<u>k.e.</u>	
First Term average- - - - -	.86-	.04-	.25-	90
Second Term average- - - - -	.71-	.03-	.30-	90
Third Term average- - - - -	.72-	.03-	.31-	90
Freshman Year average- - - -	.74-	.03-	.33-	88

Class of 1927. When the marks made by the class of 1927 in Orientation (or Agriculture, as it was then called) (cf. Table 7) are compared with the Four Year average made by the same students, a correlation of .17±.08 is obtained. This figure is but twice its P.E. and hence is not reliable. It cannot be compared with the r found to exist between Orientation and the same criterion in the classes of 1931 and 1934, for at the time this course was given (in 1923) to the class of 1927, it was given by another instructor and was an entirely different course. Consequently, there is no "norm" with which to compare this index.

Chemistry Comparisons. Chemistry correlated $.75 \pm .04$ with the Course average with the 1927 data, and this figure is reliable, since it is more than six times its probable error. This means that the same correlation, repeated with different data under similar conditions would have an even chance of having a coefficient between the range $.71$ and $.79$, and that it would have twenty-one chances to one that its coefficient would fall between $.67$ and $.83$.

This r is very high when compared with the level attained in similar correlations to date. It is higher by 23 points than the r of any other First Term subject and the same criterion, in either the class of 1931 or the class of 1927, the nearest approach to it being the relationship of Orientation and the Four Year average with 1931 data. It is also higher than any of the r 's found when the Term averages are compared with the Course average. Consequently, with the class of 1927, Chemistry was by far the best prognostic indicator of the Four Year average, and it was higher than any indicator found in the work of the class of 1931.

Applied to Hull's formula, this coefficient gives a K.e. of $.34$ which means that an individual in the class of 1927 had approximately one chance in three of making a Course average that would fall in the same interval as did his Chemistry mark. In considering this figure, however, it should be noted that it is computed from but forty-five cases and that this is a very small sample.

Mathematics Comparisons. Mathematics was a better indicator of the average of the Four Years with the class of 1931 than it was with the class of 1927. In the latter class, the relationship is expressed by the index $.44 \pm .07$. This figure is reliable but is 3 points lower than the r of the same correlation with the class of 1931 ($.47 \pm .05$). Since the limits set by their respective $P.E.$'s overlap, these two r 's may be considered, for practical purposes, approximately equal. As the r of 1927 is computed from but fifty-six cases, more studies will have to be made before this relationship between Mathematics and the Four Year average is generalized.

Table 7

Coefficients Obtained with the Data of 1927

Subject	Four Year average			
	r	$P.E.$	Cases	$K.e.$
Freshman year				
1st term- - - - -	$.450 \pm$	$.071$ - - -	56- - -	$.10$
2nd " - - - - -	$.740 \pm$	$.040$ - - -	56- - -	$.33$
3rd " - - - - -	$.499 \pm$	$.067$ - - -	56- - -	$.12$
Orientation 1- - - - -	$.175 \pm$	$.083$ - - -	56- - -	$.01$
Chemistry 4- - - - -	$.756 \pm$	$.042$ - - -	45- - -	$.34$
Mathematics- - - - -	$.440 \pm$	$.070$ - - -	56- - -	$.10$
English- - - - -	$.467 \pm$	$.170$ - - -	56- - -	$.11$

English Comparisons. Unlike Mathematics, English was a better prognostic indicator in 1927 than it was in 1931 as regards the average attained for the entire Four Years. With the class of 1927, this subject gave a coefficient of $.46 \pm .07$, a figure that is reliable, whereas the class of 1931 gave the unreliable figure of $.34 \pm .06$. With the 1927 data, English was second only to Chem-

istry in predicting the average attained for the course, though the difference between these two was considerable (29 points). When compared with the standard of perfection, however, the English marks are found to be less satisfactory, since they are but 11% efficient.

Term Average Comparisons. When the term averages are compared with the Four Year average in the class of 1927, the results are somewhat different from those obtained when the same comparisons were made with the class of 1931. It should be noted, however, that at the time the 1927 averages were computed, the Registrar's Office averaged all the marks, and when the averages of the class of 1931 were computed, compulsory Freshman Courses were omitted. Consequently, any comparisons made between the two sets of averages are incorrect, technically. For general interest, however, these will be made.

The First Term average and the Third Term average in the 1927 data correlate .45 and .07 and .49 and .06 and these figures are lower by 21 and 23 points, respectively, than the r 's obtained from the same correlations with the 1931 data. Both figures are reliable, but both are low, as regards, both the normal standard and that of perfection.

The r obtained when the Second Term averages are compared with the Course averages of the class of 1927 is much higher than that of the First and Third Terms and is higher than any of the r 's obtained with the 1931 Term averages. The index

of this relationship is $.74 \pm .04$, and it is reliable, since it is much more than the required six times greater than its $P.E.$ It is 25 points higher than any other r obtained with 1927 Term averages and the same criterion, and is 3 points higher than the coefficient found when the same comparison was made with the 1931 data. Consequently, it is high as regards normal. Unfortunately, only fifty-six cases could be used in computing this r and this number is too few to give unquestionable results.

Summary of 1927 Comparisons. The principal conclusion from this brief study is that very little use should be made of the relationships found to exist in the 1927 data. In the first place, the marks were made ten years ago, under different marking systems (in some cases) and under a different system of averaging. Second, the number of cases considered is very small. Third, there are no "norms" with which to compare the obtained coefficients. Despite these hindrances, two facts of interest are outstanding: first, the exceedingly high relationship between Chemistry and the Course average; and second, the highness of the Second Term average r when considered in the light of the r 's of the other two terms. The reasons for these two outstanding relationships cannot be definitely given until further research has been made.

IV

HIERARCHY OF ACHIEVEMENT

Problem and Method. When subjects have been found in this study to have a high correlation with succeeding work, their efficiency as prognostic indicators has been computed. Thus far, however, it has been assumed that the marks made in different courses measure the same thing. This chapter reports a study of the relationship existing between the more important subjects of the first term. Such intercorrelations are necessary to determine whether or not some of the marks can be discarded as indicators, and whether or not there is a possibility that the composite average of different marks will give a higher coefficient when correlated with succeeding averages than do the simple marks.

Professor Hull⁴³ of Yale University has stated that two principal considerations must be observed in the selection of the elements to make up a good prognostic indicator:

- "1. The tests (marks) should each correlate as highly with the criterion as possible.
2. They should correlate as low with each other as possible."

These pragmatic dicta are based on the following deduction: If two subject marks correlate highly with the criterion and with each other, they are measuring essentially the same thing; if the two marks correlate highly with the criterion and low with each other, they are measuring different things. Thus when the intercorrelation between two subjects is found to be high, and they are approximately equal in predictive efficiency (as determined in part by this section, and in part by the results of Section III), it is an

indication that both measure the same trait and that it would be more practical and less laborious to use only one. If, however, the intercorrelations show that two subject marks are of relatively high predictive value, and yet have a low coefficient when correlated with each other, then these subjects measure different traits, and if averaged together in one measure they should give a much higher index with the same criterion than do either of the subjects alone. This probability holds true only when both subjects correlate highly with the criterion. Since a time limitation imposes a definite restriction upon the scope of this thesis, composite comparisons cannot be computed. The chapter will, however, discover where these comparisons can best be made and will point the way for future research.

The technique employed in this procedure is again the product-moment method of correlation. In regard to standards, Hull⁴⁴ states that human nature is so constituted that when high correlations are secured, "reliable correlations extending below zero are rarely encountered." Hence, the standard or goal, is a zero or negative correlation between measures which correlate highly with the criterion succeeding averages. No normal standard has been adopted since, to the knowledge of the writer, no other such comparisons have been made with subject marks.

Table 8 shows the coefficient obtained from the intercorrelation of Orientation marks, Chemistry marks, Mathematics marks, and English marks, and also the r of these when compared

with the term averages of the freshman year.

Orientation Comparisons. The marks received in Orientation do not have a very high relationship with the marks received in any other first term subject, with the single exception of Chemistry. Between these subjects there is a relationship of $.51 \pm .04$, a figure which suggests that the two subjects are measuring the same capacity. Consequently, if their relationships with subsequent averages are about equal, either may be used for predictive purposes.

When compared with the mark made in English, Orientation gives an index of $.37 \pm .04$, a figure which suggests that the two subjects measure different traits. If it is later found in this study that English and Orientation have approximately the same relationship with the criterion, future college success, then these should be combined in a composite score, and this composite score correlated with the same criterion to see if a higher r can be obtained. When compared with the goal of zero, however, $.37$ is found to be unsatisfactory.

Orientation and Mathematics correlate $.33 \pm .05$, and this figure is lower than the r obtained from the intercorrelations of Orientation and any other contemporary mark. While high as regards perfection, this figure is low enough to enable one to say that if the r 's with other criteria are equal, Mathematics measures less of the same trait and more of another trait than does any other subject when compared with Orientation.

There is a higher relationship between the marks made in Orientation and the averages obtained for work done during the First Term work than between Orientation and any other criterion considered in this thesis. The relationship is .6194.03 and is reliable, being twenty times its P.E. When compared with the relationship of other subjects and the First Term average, Orientation is found to have the second highest r; only Mathematics with an r of .77 is superior. In all these studies of the relationship between First Term Subject marks and First Term averages, however, it should be remembered that it is a comparison of a part with a whole, since each subject mark is approximately three-sixteenths of the total data composing the First Term average.

When the marks made by 141 students in Orientation are compared with the Second Term averages made by these same students, a coefficient of correlation of .541.04 is obtained. This figure is reliable, for it is more than six times its P.E., and may be interpreted as meaning that the chances are even that if the correlation were repeated under similar circumstances, the coefficient of the new correlation would fall between .50 and .58, and that it would have twenty-one chances to one of falling within the range of .46 and .62.

When compared with the normal standard adopted for this thesis, this figure (.54) is about average, since the research in Section III showed that the relationship commonly found between similar sets of data ranged from .50 to .60 and

Table 8

Coefficients obtained when First Term Subject marks are compared with contemporary marks and with Term averages. Class of 1934.

Orientation			Chemistry			English			Mathematics		
r.	P.E.	K.e.	cases	r.	P.E.	K.e.	cases	r.	P.E.	K.e.	cases
Chem.	.510	.049	100								
Eng.	.370	.048	146	.307	.058	.05	111				
Math.	.336	.051	136	.570	.043	.13	105	.245	.054	.03	137
1st term											
aver.	.619	.030	142	.390	.050	.08	105	.568	.030	.17	143
2nd term											
aver.	.540	.040	141	.750	.020	.34	106	.737	.020	.31	141
3rd term											
aver.	.490	.040	141	.570	.040	.18	106	.450	.040	.10	143

.54 is about the mode of this range. It is, however, lower than the r 's obtained when Chemistry, Mathematics, and English are compared with the same criterion.

When compared with perfection, this index is not as high as one would desire. Applied to Hull's formula, .54 gives a coefficient of efficiency of .16 which means that Orientation marks predict the average of the Second Term with but 16% efficiency. In other words, there is but one chance in six that an individual will make a Second Term average that will fall in the same class-interval as was his mark in Orientation.

The relationship existing between Orientation marks and the Third Term average is expressed by the correlation coefficient, .49±.04. Since this is more than six times its P.E., this figure is reliable. This r is .05 points lower than the r found when the same marks are compared with the averages made in the Second Term, and consequently there is less relationship between Orientation and the former criterion than between Orientation and the latter criterion. It is also lower than the r 's obtained when Chemistry and Mathematics are compared with the same criterion, but is higher than the relationship with English.

When compared with perfection, Orientation is found to be only 13% efficient in predicting the average that will be made in the Third Term. Consequently, it is low for it gives an individual but two chances in fifteen of repeating the interval in which his mark fell.

Chemistry Comparisons. Chemistry has a higher relationship with contemporary marks than any other first term subject. When compared with the marks made in Mathematics, a coefficient of $.57 \pm .04$ is obtained, a reliable figure that is higher than any other obtained in these intercorrelations. Consequently, Chemistry and Mathematics measure more of the same trait than do any other two subjects. If their efficiency in predicting succeeding college averages is equal, one may be discarded as an indicator. Chemistry also correlates highly with Orientation as has been discussed previously.

When the marks made in Chemistry are compared with the marks made in English more satisfying results are obtained. Here the r is $.30 \pm .05$, a coefficient that is the second lowest obtained in all the intercorrelations, and one that is 21 points nearer the goal of zero than is the r of Chemistry and Orientation, and is 17 points lower than the r of Chemistry and Mathematics. This shows that the two subjects are measuring, to a large degree, two different capacities, and hence it is probable that, if their relationship with advanced work is the same, a correlation of a composite of these two with the same criterion would give a higher r than those which are obtained when each is compared.

When the marks made in Chemistry are compared with the averages made in the First, the Second, and the Third Terms, some surprising coefficients are obtained. Chemistry is a four credit course, and since the term averages are computed on the credit

basis (Cf. p. 11), the Chemistry mark comprises one-fourth of the data comprising the First Term average, as compared with three-sixteenths for each other subject. Consequently, it would be expected that the r of Chemistry and the First Term average would be higher than that of other First Term subjects. Yet the reverse is true. The index of Chemistry and the First Term average is $.39 \pm .05$, a figure, which, while reliable, is 17 points lower than the r of English and the same criterion, and 38 points lower than the r of Mathematics and the same Term average. Hence there is a much lower relationship between Chemistry marks and the average made in all subjects for the same Term than there is between English marks, Orientation marks, Mathematics marks, and the same criterion.

Another unexpected coefficient is obtained when the marks in Chemistry are compared with the averages made in the Sophomore Year. The index of this relationship is $.75 \pm .02$, almost twice as large as the r obtained with the First Term work. Consequently, Chemistry is 34% efficient in predicting the class in which the average obtained for the Sophomore Year will fall. This is an increase in efficiency of more than 400% over the K.e. of the same subject (.08) and the First Year average. That this is a surprising r will be realized when it is remembered that the most noticeable tendency of all the indicators considered is the almost universal decline in predictive efficiency when they are compared with more temporarily remote criteria. There have, of course, been exceptions to this tendency, but

none as outstandingly high as this.

Chemistry also predicts the average of the Third Term better than it does that of the First Term, and it is the only subject to do this. The r obtained by correlating these two variables is $.57\pm.04$, a reliable figure that is 18 points higher than the r of the same subject and the First Year average. Chemistry is high when compared with the normal standard since it is from 6 to 12 points higher than any other r of First Term subjects and subsequent term averages. It is, however, lower by 18 points than the r of the same subject, when compared with the Second Term averages.

The discussion on the relationship of Chemistry and the various criteria can be summarized by saying that it is closely related with the marks made in contemporary courses in Orientation and Mathematics and is low with regard to English marks. It has a poorer coefficient with the First Term average than has any other subject, but is far superior to all other subjects in predicting the averages of the Second and Third terms.

English Comparisons. English marks give the desired low relationship more than does any other first term subject mark. This means, if the r 's are the same with succeeding averages, that it measures a different trait than do any of the other subjects. When compared with the marks made in Orientation, English marks give an index of $.37\pm.05$, a relatively low figure,

though one which is considerably higher than the desired goal, zero. This relationship has already been discussed (cf. p. 64). The relationship existing between marks for English and Chemistry is also satisfactory ($r = .30\pm.05$) but this too has been discussed (cf. p. 66).

The lowest r of all the intercorrelations made is obtained when the marks made in English are compared with those made in Mathematics. Here the figure is $.24\pm.05$, one that indicates less correspondence in the trait measured than does any other r , and one which more nearly approaches a zero or negative correlation. Consequently, if their relationships are high with the criteria of future success, a composite mark of English and Mathematics marks should give a higher r when compared with subsequent college averages, than any other obtained.

English marks give relatively low r 's when compared with the Term averages, though the indices are higher than they were with the subject marks. The r obtained when English marks are compared with the First Term average is $.56\pm.03$, a reliable figure that is lower than the r of Orientation or Mathematics, and larger than the r of Chemistry.

When compared with the average of the Second Term, English marks, like Chemistry marks, give a higher coefficient than they do with the First Term averages. In this case, the index is $.73\pm.02$, a reliable figure that shows that English marks are second only to Chemistry marks in predicting the average of the Second Term. When compared with perfection, it is

found that this r gives a K.e. of .31 and hence an individual has almost one chance in three of repeating the class in which his mark falls.

There is a drop of almost .30 from the r obtained between English and the Second Term average and the same subject and the Third Term average. In the latter case, an index of $.45 \pm .04$ is obtained, and this figure is lower than any other r obtained from comparing English marks and the Term averages. Consequently, there is less relationship between English and the Third Term average than between English and any other term.

Mathematics Comparisons. Since the relationships existing between Mathematics and the other first term subjects have already been discussed under the headings of the other subjects, a brief summary will be all that is necessary here.

Mathematics was found to have the high correlation of $.57 \pm .04$ with Chemistry. It was low when compared with English and Orientation, giving $.24 \pm .05$ with the former and $.33 \pm .05$ with the latter. From this it will be seen that two-thirds of the comparisons made with Mathematics marks were low, as compared with one-third low with Chemistry and 100% low with English.

Strangely enough, while it has very little relationship with contemporary subjects, Mathematics has highest relationship of all First Term Subjects when compared with the First Term average. Here the correlation coefficient is $.77 \pm .02$, a

thoroughly reliable figure that is .16 points higher than the r of the second closest relationship, that of Chemistry and the same criterion. While attention has been called to this unusual relationship, further research must be made before any reason can be given for its existence. Mathematics ranks only third out of the four subjects, in relationship with the Second Term average, but this is due rather to the rise in the predictive value of Chemistry and English as discussed in the preceding sections ~~rather~~ than to an abnormal drop in the size of the Mathematics r. The index obtained is .66₁.03, a figure which is 11 points lower than the r of Mathematics and the First Term average, and consequently represents approximately the normal depreciation in predictive value which has been found in most of the relationships studied. It is, however, .07 points lower than the Chemistry r, and consequently falls from first place in predicting the First Term average to third place in predicting the Second Term average. When compared to perfection it is found to be 27% efficient.

The coefficient found when Mathematics marks are compared with the average made in the Third Term is but .51₁.04, and is that of the Second Term. Because of the drop in the predictive value of English however, Mathematics places second among the four subjects in closeness of relationship with this term's averages. Only Chemistry exceeds it, with an r of .57, and the difference is one of but 6 points. Consequently it is

high as regards the level attained by other subjects. When compared with perfection, a K.e. of .13 is obtained.

This study of Mathematics marks may be summarized by saying that Mathematics has a closer relationship with the First Term average than any other subject, that it ranks only third in relationship with the Second Term averages, and that it ranks second in predicting the Third Term average.

Interpretation of Results. The introduction of this chapter shows the possibility of obtaining a closer relationship with the criteria of college success by combining, in a composite mark, the marks of two subjects which correlated high with the criteria and low with each other, and also the possibility of avoiding duplication of effort by abandoning one subject when two are found to correlate highly with succeeding averages, and highly with each other.

In this study it was found that Chemistry and Orientation had a high relationship with each other, giving an r of .51, and it was also found that each correlated highly with the averages made during the different terms of the Freshman Year, Chemistry having an average r of .57 and Orientation an average r of .55. Since the results of the preceding section showed that Chemistry marks were but slightly higher than those of Orientation when compared with the averages made in college after the first year, it may be said that the two subjects are approximately equal as prognostic indicators of college success.

Consequently, since they are high with each other, and high with the criteria, it is not practical to use both marks for prognostic purposes. Either will do equally well from the practical standpoint, in this capacity, for the slightly higher \underline{r} 's obtained with Chemistry are balanced by the fact that Orientation considers about twenty more cases.

Approximately the same relationship holds true between the marks of Chemistry and Mathematics as between Orientation and Chemistry. Here the relationship between the marks of the two subjects is also high ($\underline{r} = .57$) and both are about equal in predicting subsequent averages, as Mathematics, while it has an average \underline{r} of .64 for predicting the term averages, is somewhat lower than Chemistry in predicting the averages made after the first year. Consequently, either may be used for predictive purposes to the exclusion of the other.

English and Orientation have a low relationship with each other, giving an \underline{r} of but .37, but they are not of equal predictive value, because, while nearly alike for the term averages of the first year (English has an average \underline{r} of .58, and Orientation has an average \underline{r} of .55), Orientation is very much superior to English in predicting the work of the more advanced years. Consequently, one cannot be adopted to the exclusion of the other, as the sole prognostic indicator, nor is it probable that their combined mark would give a high \underline{r} with the criteria.

The same low relationship holds true between English and Chemistry, and English and Mathematics. In both of these comparisons, the r of the intercorrelation is low; in both the predictive value as regards the term averages is about equal, and in both the marks made in English are considerably lower when compared with averages made in the upper college years. Hence, it is not probable that a composite average of either two sets of marks would give a higher r than do the better of these subjects.

When Mathematics and Orientation are considered, however, different results are obtained. When correlated with each other, they give a low r , .33~~1~~.06, and when each is compared with subsequent success, each gives a high correlation. In regard to the First Year term averages, the average indices are .64 and .55 respectively. In regard to averages made in the years following the first, they are about equal (cf. pp. 24+25). Thus they satisfy the prognostic dicta prescribed by Hull (cf. p. 62) in that they are low with each other and high with the criterion. This means that Mathematics and Orientation are each measuring a different trait, and that these traits are equally important in predicting success. Consequently, the combination of the marks of Orientation and Mathematics into a Composite average, ought to give a better prognostic indicator than we have at present.

A preliminary report on this problem has been made by the writer. Orientation correlates .47 with the sophomore Year

average, and .37 with the average of the first term of the Junior Year. Mathematics correlates .45 and .32 respectively with the same criteria. These r 's are relatively high. Consequently, since Chemistry and German (which have higher r 's) have only a limited number of students, it is more practical to use Orientation and Mathematics for predictive purposes than to use any other First Term subject.

When an average of the combined marks of Orientation and Mathematics is correlated with the averages of the Sophomore Year, a figure of $.44\frac{1}{2}.04$ is obtained and when correlated with averages made the First Term of the Junior Year, a figure of $.41\frac{1}{2}.05$ is obtained. The result of the first comparison is disappointing, but the result of the latter gives an r which is from 4 to 9 points higher than those obtained when the subject marks are used separately. Only an extensive comparison of the r 's of this composite mark and various term and year averages will reveal its prognostic value, but it is quite probable that such a combination of the Orientation and Mathematics marks will give a better indicator of subsequent college success than do any of the major Freshman courses.

SPECIAL CONSIDERATIONS

Problem and Method. Up to this point, this study has concerned itself only with gross interpretations of the relationships existing between the freshman marks and averages and succeeding averages. Nothing has been stated regarding individuals or small groups of individuals. Nevertheless, in practical administration work, certain questions arise as to the relationship between the lowest group in a subject, together with contemporary and subsequent averages. For example, it is desirable to know how the marks made by the lowest students in Orientation compare with the average mark in Chemistry, in English, in Mathematics, etc. It is also desirable to know to what extent the lowest ten in one subject include the lowest in others. Facts concerning the group of students at the other extreme of the scale of marks also have a practical value in answering such questions as: how do the marks of the highest in the Intelligence Tests compare with the average of the class? This chapter considers the data of the class of 1934 in regard to these problems, and attempts to answer, in part, the questions which arise from them. It is limited to the lowest ten students,⁴⁵ of those now in college, in each of the four major courses of the first term; to the ten highest in the Composite average, and to the ten highest and ten lowest in the Intelligence Test scores. Since in some cases (notably that of Mathematics) a group of ten students whose marks were lower than all others could not be found an arbitrary selection was made by taking the first ten, alphabetically, of those equally low.

The Coefficient of Correspondence (k. corr.) is the measure used in this study to show the extent to which the students in the ten lowest group in one subject are also in the ten lowest group of another subject. Consequently it may be defined as the per cent of a group of individuals who have the same relatively low position in one series of measures as they have in the other. This is simply obtained, in this study, by ranking the ten lowest students in the two subjects to be compared, and noting how many of the individuals falling in one group fall also in the other. The total number of these duplications when divided by the number in the group (ten in this case) gives a quotient which expresses, in percentages, the amount of correspondence between the groups. These coefficients are listed in Table 14.

Study of the Lowest Students. Table 9 gives the marks and averages made by the ten lowest students in Orientation. These students made an average mark in Chemistry of 67%, three points lower than the average mark of the class in that subject. In Mathematics, they made a lower mark by six points than the average of the class, for the former was 63% and the latter 70%. In English, this average mark was also six points lower than the class average, the marks being 67% and 73% respectively. This means that in terms of averages, the ten lowest students in Orientation made lower than average marks in the other three major subjects of the same term, and that they were slight-

Table 9

Marks and subsequent averages made by ten lowest students in Orientation. Class of 1934.

Orient.	Chem.	Math.	Eng.	1st term	1st year	Comp. av.	Av. without Orient.
60	71	69	60	65	74	75	64
60	73	70	70	75	68	72	78
55	67	55	70	67	68	70	69
55	63	60	55	60	66	70	59
60	60	50	65	65	70	70	58
60	67	55	66	79	80	81	52
55	68	55	65	63	70	76	65
55	50	60	75	62	65	65	62
60	63	66	72	62	70	73	62
65	69		74	74	75	77	73

Average mark

57

67

67

70

73

67

Class average mark

73

70

70

72

73

Subsequent averages include marks made in subjects not listed here.

Table 10

Marks and subsequent averages made by ten lowest students in Chemistry, Class 1934.

Chem.	Orient.	Math.	Eng.	1st term	1st year	Comp. av.	av. without Chem.
50	68	86	76	70	68	68	77
50	68	55	75	65	65	68	66
55	67	50	80	63	64	68	65
50	73	68	65	66	69	72	68
55	71	78	64	65	61	67	68
50	60	55	55	61	67	67	60
50	65	64	67	66	68	72	70
50	60	60	75	62	63	65	66
60	72	64	63	67	70	74	65
60	70	64	60	64	67	69	68
Average mark: 53	67	64	69	64	66	68	67
Class average mark: 70	73	70	73	71	72	73	

Subsequent averages include marks made in subjects not listed here.

Table 12

Marks and subsequent averages made by ten lowest students in English--Class 1934

	English	Orient.	Chem.	Math.	1st Term	1st Year	Comp.	Av. without English
	55	75	62	55	62	64	67	63
	50	60	70	63	62	68	71	64
	55	55	63	60	60	66	70	59
	55	69	64	76				68
	55	73	68	86				73
	50	67	66	60	65	67	71	64
	55	68	67	60	65	64	68	65
	50	67	90	61	74	72	69	74
	50	67	90	67	70	70	73	74
	60	71	65	73	80	74	78	69
Average Mark	53	67	69	66	67	68	70	67
Class Aver. Mark	73	73	70	70	70	72	73	

Subsequent averages include marks made in subjects not listed here.

Table 13

Comparison of the average marks made in other subjects by the ten lowest students in Orientation, Chemistry, Mathematics, and English -- Class of 1934.

<u>10 Lowest Students</u>	<u>Orient.</u>	<u>Chem.</u>	<u>Math.</u>	<u>Eng.</u>	<u>1st Term</u>	<u>1st Year Composite.</u>
Orientation	57	67	63	67	70	73
Chemistry	67	53	64	69	64	68
Mathematics	67	66	54	71	67	70
English	67	69	66	53	67	70
Average class marks	73	70	70	73	70	73

*These averages include language and other first term subject marks.

Table 14

Coefficients of correspondence obtained from comparing
the ten lowest students in each subject and subsequent average.

	Orient.	Chem.	Math.	Eng.	1st Term av.	1st Yr. av.	Comp. Av.
Orientation		.20	.30	.10	.40	.10	.10
Chemistry	.20		.30	.00	.20	.30	.20
Mathematics	.30	.30		.10	.30	.30	.20
English	.10	.00	.10		.30	.20	.10

ly better (nearer the average mark) in Chemistry than they were in Mathematics and English.

A study of the coefficients of correspondence shows that two of the students low in Orientation were also among the ten lowest in Chemistry, that three of them were lowest in Mathematics, and that only one of them was in the lowest English group. This means that the K. corr.'s. are 20%, 30%, and 10% respectively, and that Orientation, with this class, indicated more low Mathematics students than it did Chemistry students, and fewer English students than it did students of either of the other subjects.

The K. corr.'s obtained between the ten lowest students of Orientation and the ten lowest succeeding averages are 40% with the First Term average, 10% with the First Year average and 10% with the Composite average. This means that Orientation places four of its ten lowest students in the group composed of the ten lowest term averages and this figure is higher than any other K. corr. obtained with these data. The two 10%'s indicate that by the end of the First Year, three of the four students who were low in both Orientation and the First Term average had raised their average out of the low class, and that the remaining one student was still in this class at the end of the First Term of his Junior year.

When the averages made by this group of the ten lowest students in Orientation are compared with the mean of the class averages, an extremely interesting fact is noted. The

mean of the First Term average for those who were low in Orientation was 67%, as compared with a First Term class average of 70%. Consequently, it is three points lower. At the end of the First Year, this group had made an average of 70%, while the First Year class average was 72%, but two points different, and by the end of the first term of the Junior year, this group of the lowest students in Orientation had made a Composite average of 73% which is exactly equal to the Composite average of the entire class. This means that a hypothetical average student, who received a mark of 57% in Orientation, made a First Term average of 67% and was three points behind the average of his class, and that he raised his average more rapidly than did the rest of his class, so that by the end of the First Year, he was but two points behind, and that by the end of the First Term of the Junior Year, he was up to the class. Since his rate of increase is faster than that of the class, it is interesting to speculate whether or not he will have surpassed his class average by the end of his Fourth Year. This, however, is a problem which must be left for future research to solve, and many supporting studies will have to be obtained before a generalization can be made that the average student who conditions⁴⁶ Orientation with a 57% mark does better work in his succeeding years, than does the average student who gets a 70% in the same course.

Ten Lowest Students in Chemistry. The ten lowest students in Chemistry made marks which ranged from failure, through conditions to an exact 60%, and their average mark in the course was

53%, which is seventeen points lower than the average Chemistry mark of the entire class. These students made an average mark of 67% in the other major courses, and the class as a whole made 72%. When considered in detail, Table 10 shows that the average Orientation mark of the ten lowest students in Chemistry was 67%, which is six points lower than the class average mark in that subject. The average Mathematics mark made by these students is also six points lower than the class average mark for the same subject, being 64% as compared with 70%. The average mark made in English by the lowest Chemistry students is higher, relatively, than the mark in the other two courses, since it is but four points lower than the average mark of the class (69% and 73%). In every case, however, the average mark of the low Chemistry students is lower than the average mark of the class.

This is a result one expects to find when the K. corr.'s are considered, since Chemistry places two of its lowest student in the lowest group of Orientation students, three in the lowest group of Mathematics students, and none in the lowest group of English students. This gives Chemistry a series of coefficients of correspondence, with the major contemporary courses, of 20%, 30%, and 00% respectively. Since none of the Chemistry lows are in the English low group, there should be less difference between the average English mark of these students and the average English mark of the class, than there is between the two averages in other courses and this was shown to be true.

When compared with succeeding averages, the averages made by the low students of Chemistry do not show the accelerated rate of increase shown by the Orientation lows. These results show that the average of the low students is only one point nearer the average of the class at the end of the First Term of the Junior Year than it is at the end of the first term of the Freshman year. The relationships found to exist here are: 64% as compared to 70% for the Composite average. This shows that the averages of the low students and of the class were both raised two points between the end of the First Term and the end of the Freshman year, and that between the end of the Freshman Year and the end of the first term of the Junior Year, the class raised its average one point and the low students raised their average two points.

We may summarize the findings of this study of the ten lowest students in Chemistry by again referring to the hypothetical average ten-lowest student. This student would receive a mark of 53% in his Chemistry, which would be seventeen points lower than the class average. He would make an average of 67% in the other three major courses of the first term, and would receive a mark of 67% in Orientation, 64% in Mathematics, and 69% in English. His First Term average would be 64%, his First Year average would be 66% and his Composite average would be 68%, and in every mark and average made he would be below the average of his class, by from five to seventeen points.

Ten Lowest Students in Mathematics. The ten lowest students in Mathematics, as shown by Table 11, made an average mark of 54% in Mathematics, which figure is sixteen points lower than the average mark of the class in this subject. When the marks of these same students in Orientation are examined, it is found that in this subject they made an average of 67% which, while higher by one point than the average mark they made in Chemistry, is relatively the lowest average mark they made, for it is six points lower than the class average of 73%. The difference between the average mark made in Chemistry by the ten lowest students in Mathematics is 66%, which is only four points lower than the 70% average mark made by the entire class in this subject. Although lower than average, the ten lowest students in Mathematics were relatively better English students than they were students of anything else, since their average mark in this subject is but two points below the average mark of the class (71% and 73% respectively). Consequently, the average low student of Mathematics may be said to be six points below average in Orientation, four points below average in Chemistry, and two points below average in English.

Mathematics places more of its ten lowest students among the ten lowest in other subjects than does any other major subject. With Orientation, it places three in the low group and has a K. corr. of 30%, and with English it places one and has a K. corr. of 10% and with Chemistry it places three in the low group and has a K. corr. of 30%.

Consequently, Mathematics is better for choosing the lowest students of other courses than is any other subject, though the difference is slight.

Mathematics is also better than any other subject in determining the lows of the succeeding averages, since it places eight (out of a possible thirty) in the lowest groups of these criteria. Three of the lowest ten students in Mathematics are among the ten lowest in the First Term average; three are among the lowest in the First Year average; and two are among the lowest in the Composite average. This gives a range of K. corr.'s of 30%, 30%, and 20% respectively.

The mean of the averages made by the ten lowest students in Mathematics varies more in its relationship with the mean of the class averages in subsequent years than do the averages of any other low group, though the difference is but one point. The mean of Mathematics lows is 67% for the First Term average and this is three points lower than the 70% which is the mean of the class average for this term. This difference is the same as that found to exist between the same two averages with the data of Orientation and English, and is three points higher than that found in the same comparison with the Chemistry means. This can be interpreted that the low students in Mathematics make the same First Term average as do the low students in Orientation and English, and that this average is higher than that made by the low students of Chemistry for the same term.

The Mathematics students in the low group do not increase their average in the period between the First Term and the end of the First Year. In both, the mean of their averages is 67%, and since the class as a whole raises its averages to 72% for the First Year, the difference between the lows and the entire class is increased to five points. During the time between the end of the First Year and the end of the First Term Junior Year (when the Composite average was computed), the low students in Mathematics raise their averages to 70%, a jump of three points. Since during the same period, the class average rises only one point, the difference between the two is lowered to three points (70% and 73%).

This study of Mathematics marks can be summarized, as have the other studies, by reference to the average ten-low student. Such a student would make a mark of 67% in Orientation, 66% in Chemistry, and 71% in English. His First Term average would be 67%, his First Year average would be 67%, and his Composite average would be 70%. In every case, he would be below the average of his class.

Ten Lowest Students in English. The marks made by the ten lowest students in English range from 50% to 60% inclusive and average 53% (Cf. Table 12). This average is twenty points lower than the class average in the same subject, the greatest differences obtained in such comparisons.

The hypothetical average low student of English would

make a better mark, relatively and numerically, in Chemistry than he does in any other subject, since 70% is the average mark of the class in this subject, and his mark is but one point lower, 69%. In Orientation, he would make 67% which would be his poorest mark, relatively, since it is six points lower than the class average, 73%. His mark in English would be 66%, which is four points lower than the average mark of the class in this subject.

The First Term average of this student would be 67%, a figure three points lower than the class average for this term, and his First Year average would be 68%. Since the class average for the First Year is 72%, his figure would show that while he raised his average, he had done it at a slower rate than had the class so that his relative standing was poorer than it was at the end of the First Term. By the time the Composite average was computed, however, he had raised his own average two points (to 70%) and was back in the same relative position as at the end of the First Term--three points below. In every case, this average low student of English would have been below the majority of his class.

English places fewer of its lowest ten students within the ten-low group of the succeeding averages than does any other subject. There is a correspondence of but 10% with Orientation, and the same amount with Mathematics. With Chemistry, there is no correspondence. Not one of the ten lowest students.

in English falls among the ten lowest in Chemistry.

The largest English k. corr. computed is that existing between the subject and the First Term average. Here a figure of 30% is obtained, which means that three of the ten lowest students in English are among those having the ten lowest First Term average. The K. corr.'s between the lows of English and the First Year average and English and the Composite average are 20% and 10% respectively.

Summary. The most interesting fact shown by this investigation is the persistent rise in the relative standing of the subsequent averages made by the hypothetical average member of the Orientation ten-lowest group. The average of this group at the end of the First Term was 67%, a figure three points below the Class average, and at the end of the First Year, the difference had dropped to two points. By the end of the First Term of the Junior Year, the mean of the Composite average of this low group and the mean of the Composite average of the entire class were the same, 73%. The possible importance of this fact and the need for further research has been mentioned (Cf. p. 87). This study also showed that the highest percentage of correspondence between any two groups of lows occurred between the ten lowest students of Orientation and the ten with the lowest First Term average, where the figure was 40%. When compared with perfection (K. corr. = 100%) this figure is unsatisfactory⁴⁷.

In every subject considered, the average mark made by the ten lowest students in one subject was below the class aver-

age in that subject, although in the case of the English lows and the mark they made in Chemistry, the difference is only one point. The mean of the subsequent averages of these students (with the single exception of Orientation lows and the composite average mentioned above), was also consistently below the class average. This means that either the low mark they have in the subject pulls down their succeeding averages, or that, in terms of frequencies, they are poorer than average students.

Ten Highest in the Composite Average. Table 15 shows the marks made in the four major freshman courses, the averages made the First Term of the Freshman Year, and the First Year averages by the ten students ranking highest in their class at the time the Composite average was computed (end of First Term Junior Year). These marks and averages are compared with the mean of the marks and averages made by the entire class. These ten highest students in the Composite average made an average Orientation mark of 81%, and this figure is the lowest mark, both numerically and relatively, of any made in the major subjects. It is but eight points higher than the 73% average mark for the class. The mark which this group made in Chemistry is the best mark made, both numerically and relatively, for it is 87%, and is seventeen points higher than the average mark of the class. English and Mathematics marks fall between these limits, with English the higher of the two numerically, but lower, relatively, because it is but twelve points higher than the class average.

Table 15

Marks and averages made by the ten highest composite marks. Class 1934.

	Comp. av.	Orient.	Chem.	Math.	Eng.	1st Term av.	1st Yr. av.
	86	84	88	88	80	83	85
	85	75	92	85	85	85	84
	88	86	92	97	80	88	89
	85	75	--	80	81	84	85
	89	83	95	87	85	88	90
	85	81	89	93	89	83	83
	88	87	84	69	89	84	87
	85	81	89	86	96	88	88
	86	81	89	86	96	88	88
	85	79	77	75	86	80	85
Average marks	81	87	83	83	85	84	86
Class average marks	73	70	70	70	73	70	72

and the Mathematics mark, is thirteen points higher than the average class mark in this subject.

A study of the coefficients of correspondence obtained when the ten highest Composite average group is compared with the ten highest cases in each subject and average under consideration shows a tremendous variation in the percentage of relationships. Table 16 shows these K. corr.'s.

Table 16

K. corr.'s obtained when the ten highest Composite averages are compared with the ten highest group of various subjects.

	<u>Composite Average.</u>
Orientation- - - - -	.30
Chemistry- - - - -	.60
Mathematics- - - - -	.20
English- - - - -	.70
First Term average- - - - -	.40
First Year average- - - - -	.70

Orientation places only three of its ten highest students in the ten highest Composite average group, and ranks a low third among the four subjects in the size of its K. corr. This, however, is a higher figure than that of Mathematics and is higher than the K. corr. between the ten lowest groups of the same subject and average (Table 14). Consequently, it may be said that the ten highest in Orientation correspond more closely to the ten highest in the Compos-

ite average than do the highs of Mathematics and the same criterion, and that the highs of Orientation and the Composite average correspond three times as closely as do their "lows."

The correspondence between the standing of the ten highest students in Chemistry and the ten highest in Composite average is 60%, a figure which shows that Chemistry places more of its higher students in the group of the ten highest in Composite average than does any other major subject excepting English. Consequently, this relatively a high K. corr.

Mathematics places two of its ten-highest students in the group of ten that compose the highest Composite averages, and in so doing is maintaining the same K. corr. (20%) that was established between the "lows" of these two ranges. This figure, 20%, is the lowest of K. corr.'s obtained in this section.

English places seven out of its ten highest students in the group of the ten highest composite averages, and consequently has a K. corr. of 70%, a figure which is higher than that existing between any other subject-highs and the same criterion. This figure is seven times the size of the K. corr. obtained between the "lows" of these two ranges.

Four of the ten highest ranking students in the class at the end of the first term maintain their position and are among the leading ten at the end of the first term of the Junior Year, and seven of those highest at the end of the First Year maintain their standing and are in the ten highest group of the Composite average. Their K. corr.'s are .40 and .70 respectively.

Summary. This study of the ten highest ranking students at the end of the first term of their Junior Year has shown that there is less difference between the average mark which they made in Orientation and the class average mark than there was between the marks they made in other subjects and the class average of these subjects. Of these latter, the Chemistry marks were found to vary the most, being seventeen points higher. The average these students made in the First Term and the average they made the First Year are both 14 points higher than the class average for these periods.

The coefficients of correspondence revealed that English placed more of its ten-highest group in the similar group of the Composite average than did any other subject, and that Mathematics placed fewer. When the K. corr. existing between the highs of the ranges were compared with the K. corr.'s existing between the lows, it was found that only Mathematics placed equally, that Orientation and Chemistry were three times higher with the high students, and that English was seven times higher with the high group.

Intelligence Test Scores. When the scores made in the Intelligence tests by the class of 1934 are ranked and the marks of the ten highest of those still remaining in college are compared with the class average in the different major subjects, it is found (cf. Table 17) that in every course the average of the marks made by this select group is higher than the average mark of the class in this subject.

In the case of the Orientation mark, these ten highest students in the Intelligence Test scores made an average mark of 77%, which is four points higher than the average mark of the class in this subject. The average mark they made in Chemistry is 76% and this is six points higher than the class mark in Chemistry of 70%. The greatest differences of all occur in the case of the Mathematics mark. Here the class average mark is 70% and the average mark of the ten highest students in the Intelligence Test scores is 82%, a figure twelve points higher. The lowest difference of all exists between the average made by this group in English and the average mark of the class in this course. The former is 74% and the latter 73%, a difference of only one point.

The averages made by these same ten highest students in the Intelligence Test scores in the First Year and over the period measured by the Composite average are also higher by six points than the averages made by the class. The figures are 78% for the select group for the First Year average as compared to 72%, and 79% for the group in the Composite average as compared to the Class Composite average of 73%. In each of these cases there is a rise of one point in the average of the latter period.

Table 17

Comparison of marks made in various subjects by the ten highest in intelligence scores.

	Orient.	Chem.	Math.	Eng.	1st yr. av.	Comp. av.
	65	73	93	70	77	75
	53	95	87	85	90	89
	52	82	55	69	77	82
	74	66	73	54	80	81
	87	--	55	75	79	75
	72	66	55	67	70	75
	51	89	96	86	88	85
	68	50	86	76	68	68
	80	92	92	65	81	81
	50	--	70	70	75	77
Average marks	77	76	82	74	78	79
Class average marks	73	70	70	73	82	73

Table 18

Ten lowest in intelligence test scores.

	Orient.	Chem.	Math.	Eng.	1st year	Comp. av.
	72	60	53	64	70	74
	60	75	59	60	65	--
	60	70	53	50	68	71
	70	84	60	73	74	77
	55	67	55	70	68	72
	69	78	55	66	74	74
	80	72	79	82	82	83
	75	63	67	75	84	78
	67	90	61	50	72	69
	68	60	55	60	72	75
Average marks	68	71	62	65	72	74
Class average marks	73	70	70	73	72	73

Table 19

K. corr. of ten highest in Intelligence Tests with the ten highest in other measures.

Class of 1934

10% - - - - - Orientation - - - - 20%
 30% - - - - - Chemistry - - - - 00%
 40% - - - - - Mathematics - - - - 30%
 20% - - - - - English - - - - 20%

Table 20

K. corr. of ten lowest in Intelligence Tests with the ten lowest in other measures.

Class of 1934

The k. corr.'s computed between the ten-highest in the Intelligence Tests and the ten-highest in other measures are given in Table 19 above. It will be observed from this that a larger percent of the Intelligence Test group fall within the upper ten of the Mathematics group than in the upper ten of any other subject. This is about what was expected to be found, since a previous study showed that the average mark made by these students in Mathematics was twelve points higher than the class average in this subject.

Chemistry ranks next in the amount of correspondence with a K. corr. of 30%, followed by English and Orientation with K. corr.'s of 20% and 10% respectively.

Table 20 shows the comparisons made with the various marks obtained by the ten students, now in college, who ranked lowest in Intelligence Tests. These comparisons show that there is a fairly consistent tendency for the marks of these students to be lower than the average of the class. With the single ex-

ception of Chemistry, the marks made by these students in every major course were below the average of the class. In English and Mathematics, the difference between the average of the class and the average mark of the Intelligence lows was eight points, the former subject giving the select group an average of 65% as compared to a class average of 73%, and the latter giving a 62% average as compared to a 70% class average. The relationship in Orientation was one of but five points, the average marks being 73%, while the select group made but 68%. Chemistry was the exception to the tendency for the average mark of the class in this subject was below the average mark of the ten lowest students in the Intelligence Tests, though the difference was negligible.

Despite the fact that in three out of the four major courses the average mark made by the low students in Intelligence was below the class average mark, these students made a Freshman Year average that was exactly the same as the class average, and they made a Composite average that was higher than the class average. This increase, though but of one point, is significant enough to warrant more intensive research.

Table 20 shows the coefficients of correspondence obtained between the ten lowest cases of the Intelligence Test scores and the ten lowest students in various measures. Mathematics has the highest figure, a k. corr. of 30%; which means that three out of the ten low students in Intelligence are placed in the lowest ten of Mathematics. It will also be noted that

while English and Orientation are equal with k. corr.'s of 20%, Chemistry has no correspondence at all; not one of the ten lowest Intelligence Test scores was made by a student who was in the lowest ten of the Chemistry class. (Note: This study considers only those now in college.)

Summary. This brief survey of the extreme cases in the range of Intelligence Scores may be summarized by stating that in every measure, the ten highest in Intelligence Test scores made higher averages than did the class as a whole, but that the lows in Intelligence scores were lower than the average of the class in only three subjects, and that in the average of the First Year they equalled the class average and in Chemistry and the Composite average they surpassed the class average.

VI

SUMMARY, CONCLUSIONS AND DISCUSSION

1. Summary. The major purpose of this research was to determine the predictive value of the major first term, Freshman Year course marks as measured by the criterion "college success" and to compare these values with those of the Freshman year term averages, and with those of other commonly used indicators.

The study was made at the Massachusetts State College, and included three classes, 1934, 1931, and 1927. The course marks and the Term averages of these students were correlated with the succeeding averages (with some exceptions) and the coefficient of efficiency of each comparison was computed. This analysis revealed that on the whole, the marks and averages made during the Freshman terms correlated higher with the average made the Freshman year than they did with the average made the Sophomore year and more highly with the average made the Second Year than they did with the average of the First Term Junior Year and that they tended to have a coefficient of correlation with the Composite average (or Course average, when used) that was approximately equal to that of the Second Year.

It was found that there is a closer relationship between the Term averages and subsequent averages than there is between any single subject mark and the same criterion, and that in general the First Term average correlated lower with succeeding averages than did the Second Term average, and that

the Third Term correlated the highest of the three with the same criterion.

Subject marks were found to vary considerably in the closeness of their relationship with succeeding averages. With the class of 1934, German ($r =$ range .52-.76) was found to correlate the highest, though it had the fewest number of cases. Of those subjects having approximately the same number of students, Chemistry was best with an average correlation coefficient of .55. Mathematics and Orientation were about equal and were second, while English and French were low.

With but one exception, Orientation, the subject marks had less relationship with the criterion for the class of 1931 than they had for the class of 1934, and more unreliable coefficients were obtained. With this class, Orientation correlated higher with subsequent averages than did the other subjects, while Chemistry, Mathematics, and English followed in the order stated. As with the class of 1931, the term averages correlated higher with subsequent averages than did the subject marks.

The data collected from the class of 1927 were found to be of little value as changes in marking and averaging had taken place since the marks were made by this class. Chemistry had the highest relationship with the Course average, while English and Mathematics followed; and Orientation, which was then a different course, came last.

The Hierarchial Investigation. The hierarchial investigation showed that there was little relationship existing between the marks made in contemporary courses. Chemistry and Mathematics were found to correlate .57, and Chemistry and Orientation .51, while the other intercorrelations ranged from .24 to .37. The possibility of obtaining a more efficient prognostic indicator by combining the marks made in Orientation and Mathematics was pointed out and the need for more research was emphasized.

When special groups of high and low students were studied, the marks made by the ten-lowest students of each subject were found to be consistently lower than the average mark of the class. Their subsequent averages were also lower than the class averages in every case excepting Orientation, where there was a gradual rise until the Composite average of the low group equalled the mean of the Composite average of the class.

It was also found that in every case the averages made by the ten-highest students in the Composite and in the Intelligence Test scores were higher in each course than was the class average, but that when the ten "lows" in Intelligence were studied, there was no uniformity; in some subjects, they were above average, while in others, below average.

2. Conclusions. The conclusions drawn from this research, although subject to limitations, follow:

1. In general, Chemistry marks are slightly more efficient prognostic indicators of subsequent college success than are the marks in any other of the major courses of the first term of the Freshman year, although Orientation and Mathematics marks are nearly as efficient. English marks are the poorest in this respect.

2. Freshman Term averages are much superior in predicting subsequent averages than is any First Term subject mark, or any other available indicator. Each term is slightly more efficient in this respect than is the preceding term.

3. The marks made in the major courses of the First Term are superior to entrance examinations as prognostic indicators of college success.

4. The marks made in the major courses of the First Term are inferior to the Mental Test scores and High School averages as prognostic indicators of success in the first two years work, but are superior to these in predicting the success of the Junior year and of the entire four years.

5. The best available method of anticipating scholastic success is the use of the Term averages as indicators.

Recommendations. This investigation has emphasized the difference in prognostic efficiency of the various courses of the first term of the Freshman year, and the superior efficiency of the Term averages. In the light of this knowledge, the present system of

elimination at the Massachusetts State College is unjust and is founded upon questionable basis. Two possible solutions are offered below, (1) the weighting of subject marks, and (2) the adoption of a Term average basis for elimination. To the writer, the latter suggestion appears to be the better, although even the former will be an improvement over the present conditions.

1. Weighting course marks. Under the present system, the failure of 40% of the number of credits carried, automatically eliminates the student. No attempt is made to weight the course marks -- all are accepted as being equal. This system obviously places too much emphasis upon courses which have a low correlation with advanced work and could be corrected by weighting the marks of each course according to their prognostic efficiency. For example, English has an average correlation of .42 with advanced work and is the poorest of the four major subjects in this respect. Therefore a failure in English does not signify an inability to do advanced work to the same extent as does a failure in German, or in Chemistry, and consequently should not have the same influence as these subjects in determining elimination. This situation may be corrected by weighting the mark made in each course so that the part they play in the elimination of poor students will be proportional to their relative prognostic efficiency. That is, English with a K.e. of 9% would count 1 point towards elimination (let us say) while German with a K.e. of 23% would count $2\frac{1}{2}$ points. The exact details of such a method

could be easily worked out if the system is adopted and the work involved would be small since only the low students would have to be considered.

2. Adoption of Term Averages as Indicators. This investigation has shown that the average of the First Term's work correlates higher with subsequent averages than does the marks of any of the major courses, the scores of the Intelligence tests, the High School marks, or the Entrance Examination marks. In other words, the First Term average is more efficient as a prognostic indicator of college success than is any other, single, available measure. Consequently, it should be adopted as the basis of elimination.

The present system does not take into account the general average of the students conditioning or failing 40% of their credits. Because of this an investigation of the Term average of those members of the class of 1934 who were eliminated the first term shows that even with 40% of their credits below 60%, six out of nineteen made averages between 60-65% while nineteen of those not eliminated made averages in the same interval. This means that in terms of prognostic efficiency, 33 1/3% of the students who flunked out would have the same chance for future college success as 12% of those who remained; or, stated differently, 12% of those who remained in college had no more chance of future success than had 33 1/3% of those who were forced to leave. This may be interpreted as meaning that the present system is not only

unjust in selecting those it permits to remain in college, but that it is too lax.

It is therefore the recommendation of the writer that student elimination in the First Term of the Freshman year be based upon the average mark made during that term and that any term average below 65% be considered a failure.

As an alternative and less satisfactory correction, it is recommended that the present system be modified to permit the weighting of the subject marks.

APPENDIX

NOTES----

Section I

1. Munroe, Paul, A Brief Course in the History of Education, 1923, pp. 254-272.
2. Weeks, A. D., Education of Tomorrow, 1913, pp. 217-226, Also, Kilpatrick, W. H., Education for a Changing Civilization, 1926, pp. 53-88.
3. Wilson, C. M., and Hoke, K. J., How to Measure, 1921, pp. 264-266.
4. Starch, Daniel, Educational Psychology
5. Boring, Edwin G., A History of Experimental Psychology, 1929, pp. 472-476.
6. Boring, Ibid, and Holway, Comparative Validity of Scholastic Aptitude Tests, both have excellent discussions of the various types of tests.
7. Odell, C. W., Predicting Scholastic Success of College Students, Univ. of Ill. Bull., 37:11, 1927.
8. Report of Land Grant College Survey, Bull., U. S. Bureau Ed., 9:1930:345.
9. C.f. Nomenclature, p. 16.
10. Odell, C. W., Are College Students a Select Group? Univ. Ill. Bull. 34:1927:42.
11. Quoted by Odell, C. W., Predicting Scholastic Success of College Students, Univ. Ill. Bull. 37:1927:11.
12. McDonnell, Anna H., Comparative Validity of High School Marks and Mental Test Records:1927, p. 58.
13. Crane, Esther, An Investigation of Three Plans for Selecting Students, Jour. Ed. Res. 17:322-330:1926.
14. Holway, op. cit., p. 10.
15. Holway, loc. cit.
16. MacPhail, A. H., The Intelligence of College Students, 1927. Quoted by Holway, loc. cit.
17. Scott, W. D., Intelligence Tests for Prospective Freshmen, Sch. and Soc., 15, 385, 1922.
18. Balenbaugh, L, and Proctor, W. M., Relation of the

19. Crawford, A. B., Forecasting Freshman Achievement, Sch. and Soc., 31:125-132, 1930.
20. Good, C. V., Higher Education, Orientation in Education, 1932.
21. Wood, Ben, D., Measurement in Higher Education, 1923, p. 131.
22. McDonnell, Op. cit., p. 62.

Section II

23. Orientation, Chemistry, Mathematics, and English are required of most Freshman; there is a choice between French and German.
24. McDonnell, op. cit., pp. 1-120, particularly p. 58.
25. The results of the Army Alpha Test used by McDonnell gave a mean of 146 and a range of 78 to 196. This same test, when given to the class of 1934, had a mean of 148 and a range of 94 to 187. This similarity justifies the adoption of McDonnell's data.
26. Stated by Professor H. N. Glick in a class-room discussion.
27. Plantinga, S. I., Validity of a Battery of Mental Tests Master's Thesis, M. S. C., 1930, p. 53.
28. Munroe, W. S., An Introduction to the Theory of Educational Measurement, 1923, pp. 336-344.
29. Schulte, T. H., Educational Statistics, Orientation in Education, 1932, p. 73.
30. Trow, W. C., Educational Psychology, 1931, p. 171.
31. Rugg, H. O., Statistical Methods Applied to Education, 1917, pp. 256-257.
32. Jordan, A. M., Educational Psychology, 1928, p. 274.
33. Harper, F. H., Elements of Practical Statistics, 1930, pp. 197-198, Quoted by Holway, op. cit., pp. 75-76.
34. Hull, C. L., The Correlation Coefficient and its Prognostic Significance, Jour. Ed. Res. 15; 1927; 332.
35. The author is indebted to Holway, op. cit., pp. 76-77, for the idea of adopting a dual standard.
36. Hull, C. L., op. cit., p. 337.

37. Munroe, W. S., loc. cit.
38. Munroe, W. S., op. cit., p. 329.
39. Munroe, W. S., op. cit., p. 347.
40. Jordan, op. cit., p. 275.
41. Otis, A. S., Statistical Method in Educational Movement 1926, p. 227.

Section III--

42. For practical purposes such comparisons are valuable, but actually the coefficients obtained by correlating Mental Test scores and the First Term average, and advanced averages cannot be compared with the correlation of First Term averages and the same criteria as the First Term average is in part identical with the criteria.

Section IV--

43. Quoted by Holway, op. cit., p. 115.
44. Loc. cit.

Section V--

45. The terms highs and lows will be used to designate the ten highest and the ten lowest students in each subject.
46. A course is "conditioned" when the student makes a mark of 55-60%. He is given a chance to repeat his examination.
47. It should be noted in this respect that only those students now in college were studied and this group has survived because there was a low L. corr. between the lows in each subject: those making a high K. corr. were eliminated.

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